

DMS-DR-1003

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N71-35102

-SPACE SHUTTLE-

MMC PHASE A SPACE  
SHUTTLE MODIFIED ORBITER

INVESTIGATION OF  
STABILITY CHARACTERISTICS  
AND CONTROL EFFECTIVENESS

WIND TUNNEL TEST RESULTS  
DATA REPORT  
JULY, 1970

CONTRACT NAS8-4016  
SCHEDULE II  
AMENDMENT 126

CASE FILE  
COPY

SADSAC SPACE SHUTTLE  
AEROTHERMODYNAMIC  
DATA MANAGEMENT SYSTEM

SPACE DIVISION CHRYSLER  
CORPORATION

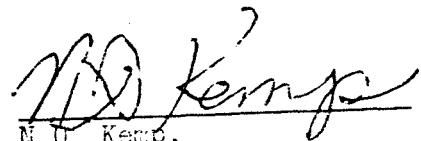


## PREFACE

This document is a compilation of wind tunnel test information and data collected at NASA facilities and submitted in fulfillment of SADSAC dry run requirements.

The primary purpose of this document is to demonstrate joint capability of the Space Shuttle Data Management System and the NASA facility to convert wind tunnel test data into a data report using the SADSAC Computer System. The SADSAC program used in this demonstration is the Phase B Version I (dry run) system which is the initial Phase B program configuration. The capability of this version is deliberately restricted as its purpose is to demonstrate overall system throughput capability. The Version II program is slated for full Phase B operational capability.

The reproduction of plots is by an interim XEROX means using a secondary master. Standard report reproduction will be by an offset process using a direct film image offset master. Also, standard production plots will be printed back to back, thereby reducing the bulk of the report.



N.D. Kemp,  
SADSAC Technical Manager

REPORT NUMBER: DMS-DR-1003

PUBLISHED: JULY, 1970

SPACE SHUTTLE  
WIND TUNNEL TEST  
DATA REPORT

TEST FACILITY: NASA MSFC 14-INCH TRISONIC WIND TUNNEL: TEST NO. 453

CONFIGURATION: MMC PHASE A SPACE SHUTTLE MODIFIED ORBITER

MODEL SCALE: 0.0038

TEST PURPOSE: INVESTIGATION OF STABILITY CHARACTERISTICS  
AND CONTROL EFFECTIVENESS

MACH NUMBER RANGE: 0.4 TO 4.95

TESTS CONDUCTED BY:

MARTIN MARIETTA CORPORATION, DENVER, COLORADO

TEST CONDUCTOR(S) DALE SARVER

TEST DATE: MARCH 1970

(This report has been prepared by Chrysler Corporation Space Division, under a Data Management Contract to NASA. Chrysler assumes no responsibility for the data presented herein other than its display characteristics.)

## TABLE OF CONTENTS

	PAGE
<b>List of Figures</b>	<b>iii</b>
<b>Abstract</b>	<b>1</b>
<b>Test Conditions</b>	<b>2</b>
<b>Data Reduction</b>	<b>3</b>
<b>Configurations Investigated</b>	<b>4</b>
<b>Data Set Collations</b>	<b>11</b>
<b>Test Facility Description</b>	<b>13</b>
<b>Nomenclature</b>	<b>14</b>
<b>Test Results</b>	<b>19</b>
<b>Figures</b>	<b>20</b>
<b>Data Display Index</b>	<b>26</b>
<b>Data</b>	<b>29</b>

LIST OF FIGURES

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
1.	Axis systems, showing direction and sense of force and moment coefficients, angle of attack, and sideslip angle.	21
2.	Modified Orbiter Configuration (B2W2T1E1R1)	22
3.	Model Component Sketch (B2)	23
4.	Model Component Sketch (W2E1 and T1R1)	24
5.	Photograph of Modified Orbiter Configuration (B2W2T1E1R1)	25

## ABSTRACT

A 0.0038 scale model of the Martin Marietta Corporation Phase A Space Shuttle Modified Orbiter was tested in the NASA MSFC 14-inch trisonic wind tunnel during March 1970. This force and moment test was conducted to determine the effect of increased camber on the orbiter stability characteristics. The model was tested at a Mach number range of 0.4 to 4.95 at pitch angles of -4° to 25° and at zero sideslip. The model was tested with the elevons and rudders off, at elevon deflections of 0, -15°, and -30°, and at zero rudder deflections. The purpose of this report is to present the test data for this test.

TEST CONDITIONS  
TEST MSFC TINT 453

BALANCE UTILIZED: NASA MSFC 5/8 in. dia. internal strain gage balance #226

卷之三

### ACCURACY:

## **COEFFICIENT TOLERANCE**

NE ± 150 LBS.

**± .5 lbs.**

**ANSWER**

SF ± 50 Lbs.

~~1.5 lbs.~~

AF  $\pm$  30 in.-lb.

~~± .5 IBS.~~

**REFERENCES** See page 100.

PM \_\_\_\_\_  
YM \_\_\_\_\_

~~1.5 IN-16.~~

—

RM ± 40 in-1b

± .5 in.-lb

*Journal of Health Politics, Policy and Law*, Vol. 27, No. 4, December 2002  
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COMMENTS: STATED ACCURACY is based on repeatability  
and check-loadings

## DATA REDUCTION

Balance six component force and moment data were reduced about the body axis with the origin at the model moment reference point located as described on the Data Set Descriptor Sheet and Figure 2. Forces and moments were converted to coefficient form by use of the model total planform area, total span, and total body length. Base and balance chamber pressures were reduced to coefficient form and used to provide an axial force coefficient for the model with the base and balance chamber pressures adjusted to the free stream static pressure. The total axial force coefficients ( $C_A$ ) were utilized to compute the stability axis lift-to-drag ratio ( $C_D$ ) values.

## CONFIGURATIONS INVESTIGATED

### NOMENCLATURE

B2 = Modified Orbiter Body  
W2 = Modified Orbiter Double Delta Wind  
T1 = Vertical Stabilizer, Constant Taper, Constant Sweep, Dimensions Include Rudder  
R1 = Simple Hinged Rudder  
E1 = Constant Chord, Simple Hinged Elevon

Refer to the immediately following pages for model component dimensional data.

### CONFIGURATIONS TESTED

B2W2E1

B2W2T1R1

B2W2T1E1R1

Figures 2, 3 and 4 are sketches of the MMC Modified Orbiter Configuration and Figure 5 is a photograph of the model. Elevon and rudder deflection were obtained by using interchangeable model components. Boundary layer transition was initiated by utilizing carborundum grit strips on the model nose, wing

and vertical tail as follows:

	<u>Nose</u>	<u>Wing</u>	<u>Vertical Tail</u>
Thickness (inches)	0.125	0.060	0.030
Location (inches aft of Leading Edge)	0.150	0.050	0.050
Grit Size:			
Mach number = 0.4 to 1.2	#120	#120	#120
Mach number = 2.74 to 3.48	# 80	#120	#120
Mach number = 4.95	# 36	#120	#120

All of the above distances were measured perpendicular to the surface leading edges. The orbiter model utilized in MSFC TWT 442 was modified and utilized in MSFC TWT 453; the modification was the application of "DEVCOM" to the external surfaces to increase the model camber. Six component force and moment data were measured with the NASA MSFC No. 226, 5/8 inch diameter internal strain gage balance. The balance chamber pressure was measured by utilizing a pressure tube orifice in the model balance cavity. The base pressure was measuring by using a pressure tube orifice in the model base area. Differential pressure transducers, referenced to the facility pressure reference system, were utilized to measure these pressures.

MODEL COMPONENT: BODY - B<sup>2</sup>

GENERAL DESCRIPTION: MODIFIED ORBITER BODY

DRAWING NUMBER:

WT6917002

DIMENSIONS:

	<u>FULL-SCALE</u>	<u>MODEL SCALE</u>
Length	<u>165 ft.</u>	<u>7.52 in.</u>
Max. Width	<u>16.5 ft.</u>	<u>.75 in.</u>
Max. Depth	<u>26.3 ft.</u>	<u>1.28 in.</u>
Fineness Ratio	<u>4.17</u>	<u>4.17</u>
Area		
Max. Cross-Sectional	<u>68.2 ft.<sup>2</sup></u>	<u>1.42 in.<sup>2</sup></u>
Planform	<u>3,610 ft<sup>2</sup></u>	<u>7.50 in<sup>2</sup></u>
Wetted	<u>11,530 ft<sup>2</sup></u>	<u>23.94 in<sup>2</sup></u>
Base	<u>38.64 ft<sup>2</sup></u>	<u>.804 in<sup>2</sup></u>

MODEL COMPONENT: WING ~ W<sup>2</sup>

GENERAL DESCRIPTION: MODIFIED ORBITER DOUBLE  
DELTA WING

DRAWING NUMBER:

WT 6917002

DIMENSIONS:

FULL-SCALE

MODEL SCALE

TOTAL DATA

Area

Planform

Wetted

Span (equivalent)

81 ft.

3.67 in.

Aspect Ratio

Rate of Taper

Taper Ratio

Diehedral Angle, degrees

0

0

Incidence Angle, degrees

0

0

Aerodynamic Twist, degrees

0

0

Toe-In Angle

Cant Angle

Sweep Back Angles, degrees

Leading Edge

67.5

67.5

Trailing Edge

30

30

0.25 Element Line

Chords:

Root (Wing Sta. 0.0)

Tip, (equivalent)

MAC, inches

Fus. Sta. of .25 MAC

W.P. of .25 MAC

Airfoil Section

Root

Tip

EXPOSED DATA

Area

3810 ft.<sup>2</sup>

7.91 in.<sup>2</sup>

Span, (equivalent)

25.2 ft.

1.15 in.

Aspect Ratio

1.66

1.66

Taper Ratio

.223

.223

Chords

Root

131.5 ft.

6.00 in.

Tip

29.4 ft.

1.34 in.

MAC

97 ft.

4.43 in.

Fus. Sta. of .25 MAC

1394 in.

5.3 in.

W.P. of .25 MAC

MODEL COMPONENT: TAIL ~ T'

GENERAL DESCRIPTION: VERTICAL STABILIZER,  
Constant taper, Constant sweep,  
dimensions include rudder

DRAWING NUMBER:

WT6917002

DIMENSIONS:

TOTAL DATA

	<u>FULL-SCALE</u>	<u>MODEL SCALE</u>
Area		
Planform	<u>665 ft.<sup>2</sup></u>	<u>1.38 in.<sup>2</sup></u>
Wetted	<u>1330 ft.<sup>2</sup></u>	<u>2.76 in.<sup>2</sup></u>
Span (equivalent)	<u>30 ft.</u>	<u>1.37 in.</u>
Aspect Ratio	<u>1.35</u>	<u>1.35</u>
Rate of Taper		
Taper Ratio	<u>.303</u>	<u>.303</u>
Diehedral Angle, degrees	<u>15</u>	<u>15</u>
Incidence Angle, degrees		
Aerodynamic Twist, degrees	<u>0</u>	<u>0</u>
Toe-In Angle	<u>5</u>	<u>5</u>
Cant Angle		
Sweep Back Angles, degrees		
Leading Edge	<u>48</u>	<u>48</u>
Trailing Edge	<u>15</u>	<u>15</u>
0.25 Element Line	<u>41.5</u>	<u>41.5</u>
Chords:		
Root (Wing Sta. 0.0)	<u>33 ft.</u>	<u>1.55 in.</u>
Tip, (equivalent)	<u>10 ft.</u>	<u>.47 in.</u>
MAC, inches	<u>23.6 ft.</u>	<u>1.05 in.</u>
Fus. Sta. of .25 MAC	<u>1740 in.</u>	<u>6.57 in.</u>
W.P. of .25 MAC		
Airfoil Section		
Root		
Tip		

EXPOSED DATA

Area	<u>665 ft.<sup>2</sup></u>	<u>1.38 in.<sup>2</sup></u>
Span, (equivalent)	<u>30 ft.</u>	<u>1.37 in.</u>
Aspect Ratio	<u>1.35</u>	<u>1.35</u>
Taper Ratio	<u>.303</u>	<u>.303</u>
Chords		
Root	<u>33 ft.</u>	<u>1.55 in.</u>
Tip	<u>10 ft.</u>	<u>.47 in.</u>
MAC	<u>23.6 ft.</u>	<u>1.05 in.</u>
Fus. Sta. of .25 MAC	<u>1740 in.</u>	<u>6.57 in.</u>
W.P. of .25 MAC		

MODEL COMPONENT: RUDDER ~ R'

GENERAL DESCRIPTION: Simple hinged rudder

DRAWING NUMBER: WT6917002

<u>DIMENSIONS:</u>	<u>FULL-SCALE</u>	<u>MODEL SCALE</u>
Area	<u>274 ft.<sup>2</sup></u>	<u>.570 in.<sup>2</sup></u>
Span (equivalent)	<u>26.5 ft.</u>	<u>1.218 in.</u>
Inb'd equivalent chord	<u>12 ft.</u>	<u>.550 in.</u>
Outb'd equivalent chord	<u>8 ft.</u>	<u>.370 in.</u>
Ratio Elevator chord/ tail chord		
At Inb'd equiv. chord	<u>.374</u>	<u>.374</u>
At Outb'd equiv. chord	<u>.823</u>	<u>.823</u>
Sweep Back Angles, degrees		
Leading Edge	<u>22</u>	<u>22</u>
Tailing Edge	<u>15</u>	<u>15</u>
Hingeline	<u>22</u>	<u>22</u>
Area Moment (Normal to hinge line)		

MODEL COMPONENT: ELEVON ~ E'

GENERAL DESCRIPTION: Constant Chord, Simple hinged ELEVON

DRAWING NUMBER:

WT6917002

DIMENSIONS:

	<u>FULL-SCALE</u>	<u>MODEL SCALE</u>
Area	<u>351 ft.<sup>2</sup></u>	<u>.731 in.<sup>2</sup></u>
Span (equivalent)	<u>28 ft.</u>	<u>1.277 in.</u>
Inb'd equivalent chord	<u>12 ft.</u>	<u>.575 in.</u>
Outb'd equivalent chord	<u>12 ft.</u>	<u>.575 in.</u>
Ratio Elevator chord/horizontal tail chord		
At Inb'd equiv. chord	<u>.096</u>	<u>.096</u>
At Outb'd equiv. chord	<u>.371</u>	<u>.371</u>
Sweep Back Angles, degrees		
Leading Edge	<u>30</u>	<u>30</u>
Tailing Edge	<u>30</u>	<u>30</u>
Hingeline	<u>30</u>	<u>30</u>
Area Moment (Normal to hinge line)		

TEST MSFC TWT 453 DATA SET COLLATION SHEET

PRETEST       POSTTEST

### **COEFFICIENTS:**

$$\begin{array}{l} \alpha_A = -4^\circ / +16^\circ \\ \alpha_S = +10^\circ / +25^\circ \end{array}$$

AORÉ  
SCHEDULES

**TEST MSFC TWT453** DATA SET DESCRIPTOR SHEET

DATA SET IDENTIFIER	DATA SET DESCRIPTOR	CURVE SLOPE RANGE
R17021	MSEC 453 MMG M012 QFB 62M2E1 D6L EQ	11 -1.5 11.5
R17022		11 -1.5 11.5
R17023		11 -1.5 11.5
R17024	B2W2T1F1 D6L R0	11 -1.5 11.5
R17025	B2W2T1E1R1 D6L EC R0	11 -1.5 11.5
R17026	E-15 R0	11 -1.5 11.5
R17027	F-3C RC	11 -1.5 11.5
R17028	E-15 R0	11 -1.5 11.5
R17029	E-3C R0	11 -1.5 11.5
R17030		11 -1.5 11.5

11 21 31 41 51      11 21 31 41 51

REFERENCE AREA      LONGITUDINAL      LATERAL      LONGITUDINAL      LATERAL      VERTICAL  
 $S_R$        $\lambda_R$       b<sub>R</sub>      XMRP      YMRP      ZMRP      SOURCE DOCUMENT  
 REFERENCE LENGTH      MOMENT REFERENCE POINT

## TEST FACILITY DESCRIPTION

The Marshall Space Flight Center 14" x 14" Trisonic Wind Tunnel is an intermittent blowdown tunnel which operates by high pressure air flowing from storage to either vacuum or atmospheric conditions. A Mach number range from .2 to 5.85 is covered by utilizing two interchangeable test sections. The transonic section permits testing at Mach 0.20 through 2.50, and the supersonic section permits testing at Mach 2.74 through 5.85. Mach numbers between .2 and .9 are obtained by using a controllable diffuser. The range from .95 to 1.3 is achieved through the use of plenum suction and perforated walls. Mach numbers of 1.44, 1.93 and 2.50 are produced by interchangeable sets of fixed contour nozzle blocks. Above Mach 2.50 a set of fixed contour nozzle blocks are tilted and translated automatically to produce any desired Mach number in .25 increments.

Air is supplied to a 6000 cubic foot storage tank at approximately -40°F dew point and 500 psi. The compressor is a three-stage reciprocating unit driven by a 1500 hp motor.

The tunnel flow is established and controlled with a servo actuated gate valve. The controlled air flows through the valve diffuser into the stilling chamber and heat exchanger where the air temperature can be controlled from ambient to approximately 180°F. The air then passes through the test section which contains the nozzle blocks and test region.

Downstream of the test section is a hydraulically controlled pitch sector that provides a total angle of attack range of 20° ( $\pm 10^\circ$ ). Sting offsets are available for obtaining various maximum angles of attack up to 25°.

The diffuser section has movable floor and ceiling panels which are the primary means of controlling the subsonic Mach numbers and permit more efficient running supersonically. The sector assembly and supersonic diffuser telescope into the subsonic diffuser to allow easy access to the model and test section.

Tunnel flow is exhausted through an acoustically damped tower to atmosphere or into the vacuum field of 42,000 cubic feet. The vacuum tanks are evacuated by vacuum pumps driven by a total of 500 hp.

Data is recorded by a solid state digital data acquisition system. The digital data is transferred to punched cards during the run to be reduced later by a computer to proper coefficient form.

The tunnel components and performance are discussed in more detail in NASA TM X-53185, dated December 22, 1964, and NASA TM X-53113, dated August 20, 1964.

## NOMENCLATURE

<u>SYMBOL</u>	<u>SADSAC SYMBOL</u>	<u>DEFINITION</u>
$A_b$		base area; m <sup>2</sup> , ft <sup>2</sup> , in <sup>2</sup>
a		speed of sound; m/sec, ft/sec
AR	ASPECT	aspect ratio, $b^2/S$
b	REFB	wing span or reference span; m, ft, in
c		wing chord; m, ft, in
$\bar{c}$		wing mean aerodynamic chord or reference chord; m, ft, in
c. g.		center of gravity
C. P.		center of pressure
$C_A$	CATOTL	axial force coefficient, $F_A/q S_{ref}$
$C_{A_b}$	CABASE	base axial force coefficient, $[(p_\infty - p_b)/q] (A_b/S_{ref})$
$C_{Af}$	CAFORE	forebody axial force coefficient, $C_A - C_{A_b}$
$C_D$	CDTOTL	drag force coefficient in the wind axis system, $F_D/q S_{ref}$
$C'_D$	CD	drag force coefficient in the stability axis system, $F'_D/q S_{ref}$
$C_L$	CL	lift force coefficient (stability or wing axis) $F_L/q S_{ref}$
$C_\ell$	CRL	rolling moment coefficient in body axis system, $M_x/q S_{ref} b$
$C_{\ell,s}$	CSL	rolling moment coefficient in the stability axis system, $M_{x,s}/q S_{ref} b$
$C_{\ell,w}$	CWL	rolling moment coefficient in the wind axis system, $M_{x,w}/q S_{ref} b$

NOMENCLATURE (Continued)

<u>SYMBOL</u>	<u>SADSAC SYMBOL</u>	<u>DEFINITION</u>
$C_m$	CNM	pitching moment coefficient in the body axis system, $M_y/q S_{ref} \lambda_{ref}$
$C_{m,s}$	CNM	pitching moment coefficient in the stability axis system, $C_{m,s} = C_m$
$C_{m,w}$	CWM	pitching moment coefficient in the wind axis system, $M_{y,w}/q S_{ref} \lambda_{ref}$
$C_N$	CN	normal force coefficient in the body axis system, $F_N/q S_{ref}$
$C_n$	CYM	yawing moment coefficient in the body axis system, $M_z/q S_{ref} b$
$C_{n,s}$	CWN	yawing moment coefficient in the stability axis system, $C_{n,s} = C_n$
$C_{n,w}$	CWN	yawing moment coefficient in the wind axis system, $M_{z,w}/q S_{ref} b$
$C_p$	CP	pressure coefficient, $(p - p_\infty)/q$
$C_y$	CY	side force coefficient (body or stability axis system), $F_y/q S_{ref}$
$F_A$		axial force; N, lb
$F_D$		drag force in wind axis system; N, lb
$F'_D$		drag force in the stability axis system; N, lb
$F_L$		lift force (stability or wind axis system); N, lb
$F_N$		normal force; N, lb
$F_Y$		side force; N, lb
$\lambda_{ref}$	REFL	reference length ; m, ft, in
L/D	L/D	lift-to-drag ratio, $C_L/C_D$
M	MACH	Mach number

## NOMENCLATURE (Continued)

<u>SYMBOL</u>	<u>SADSAC SYMBOL</u>	<u>DEFINITION</u>
MRP	MRP	abbreviation for moment reference point
$M_x$		rolling moment in the body axis system; N-m, ft-lb
$M_{x,s}$		rolling moment in the stability axis system; N-m, ft-lb
$M_{x,w}$		rolling moment in the wind axis system; N-m, ft-lb
$M_y$		pitching moment in the body (or stability) axis system; N-m, ft-lb
$M_{y,w}$		pitching moment in the wind axis system; N-m, ft-lb
$M_z$		yawing moment in the body axis system; N-m, ft-lb
$M_{z,w}$		yawing moment in the wind axis system; N-m, ft-lb
p		static pressure; N/m <sup>2</sup> ; psi
P		total pressure; N/m <sup>2</sup> ; psi
q	Q(PSI) Q(PSF)	dynamic pressure; N/m <sup>2</sup> , psi, psf
RN/L	RN/L	Reynold's number per unit length; million/ft.
S		characteristic area; m <sup>2</sup> , ft <sup>2</sup>
$S_{ref}$	REFS	reference area; m <sup>2</sup> , ft <sup>2</sup>
T		temperature; °K, °C, °R, °F
V		speed of vehicle relative to surrounding atmosphere; m/sec, ft/sec

NOMENCLATURE (Continued)

<u>SYMBOL</u>	<u>SADSAC SYMBOL</u>	<u>DEFINITION</u>
$\bar{V}$		velocity of vehicle relative to surrounding atmosphere; m/sec, ft/sec
$\alpha$	ALPHA	angle of attack, angle between the projection of the wind $X_w$ -axis on the body X, Z - plane and the body X-axis; deg
$\beta$	BETA	sideslip angle, angle between the wind $X_w$ -axis and the projection of this axis on the body X-Z-plane; deg
$\gamma$		ratio of specific heats
$\Gamma$	DIHDRL	wing dihedral angle; deg
$\delta$		control surface deflection angle; deg positive deflections are: aileron - left aileron trailing edge down elevator - trailing edge down rudder - trailing edge to the left flap - trailing edge down tab - trailing edge down with respect to control surface
$\rho$		air density; $K_g/m^3$ , slugs/ $ft^3$
$\theta$		pitch angle, angle of rotation about the body Y-axis, positive when the positive Z-axis is rotated toward the positive X-axis; deg
$\phi$	PHI	roll angle, angle of rotation about the body X-axis, positive when the positive Y-axis is rotated toward the positive Z-axis; deg
$\psi$	PSI	yaw angle, angle of rotation about the body Z-axis, positive when the positive X-axis is rotated toward the positive Y-axis; deg

## NOMENCLATURE (Continued)

<u>SUBSCRIPTS</u>	<u>DEFINITION</u>
a	aileron
b	base
c	canard
e	elevator or elevon
f	flap
r	rudder or ruddervator
s	stability axis system
t	tail, or total conditions
w	wind axis system
ref	reference conditions

## TEST RESULTS

Balance problems were encountered during TWT 453. The problems were corrected immediately after their discovery. All tests conducted with balance problems were re-run after the balance was repaired. The MSFC TWT data acquisition system encountered an insoluable problem during TWT 453. This caused sporadic bad data points; these bad points were manually deleted from the data.

Check loads hung at the end of test 453 showed that a negative normal force load of 100 lbs applied 3.3 inches aft of the model nose caused model fouling on the balance chamber pressure tube. The pitching moment associated with this loading was found to be of a larger magnitude than encountered during the test.

Orbiter model elevons were not exactly symmetric. The right elevon did not fit as closely to the fuselage mold line as did the left elevon. The left elevon trailing edge extended slightly aft of the wing trailing edge.

## **FIGURES**

**Notes:**

1. Positive directions of force coefficients and angles are indicated by arrows.
2. For clarity, origins of wind and stability axes have been displaced from the center of gravity.

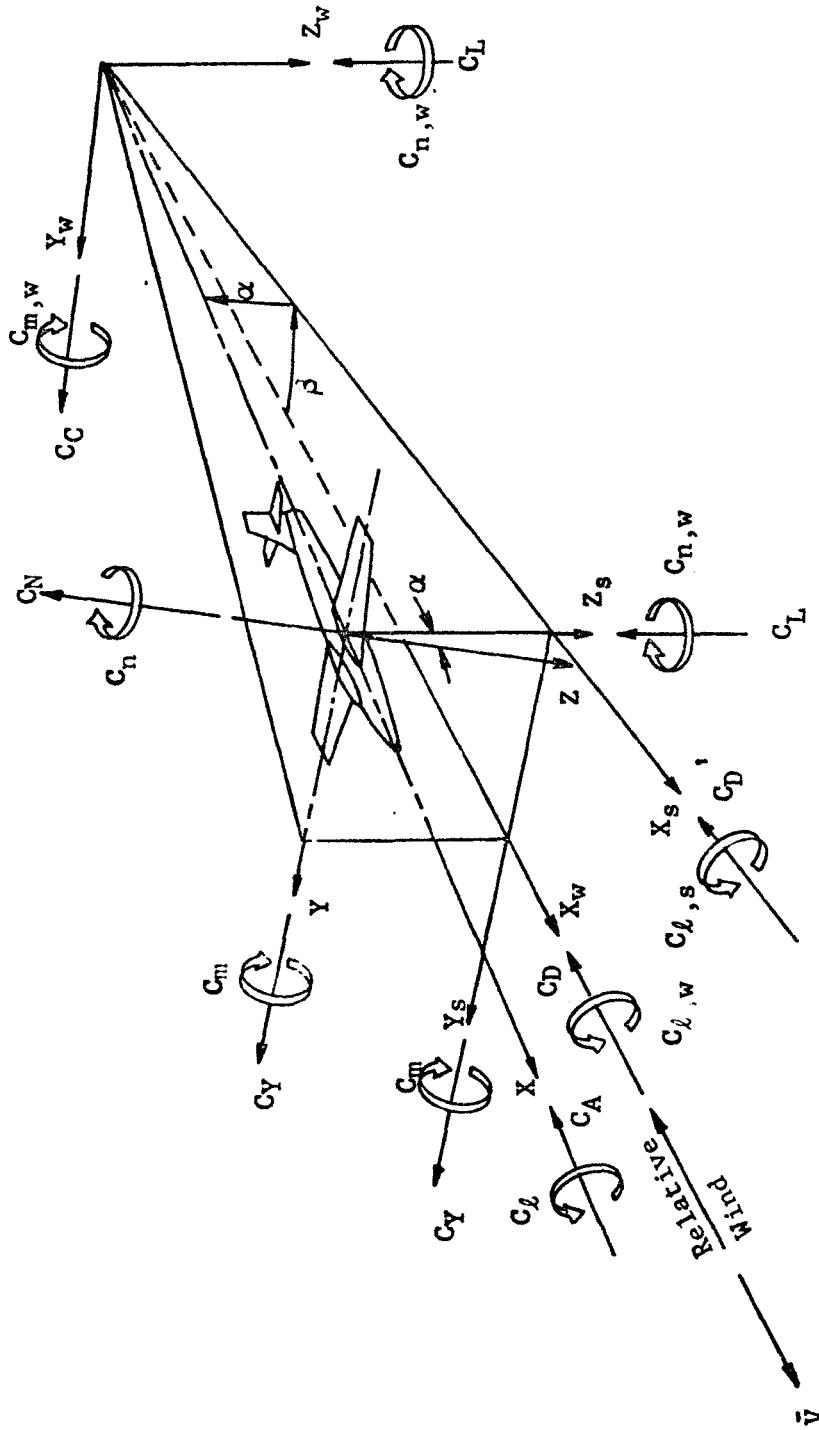
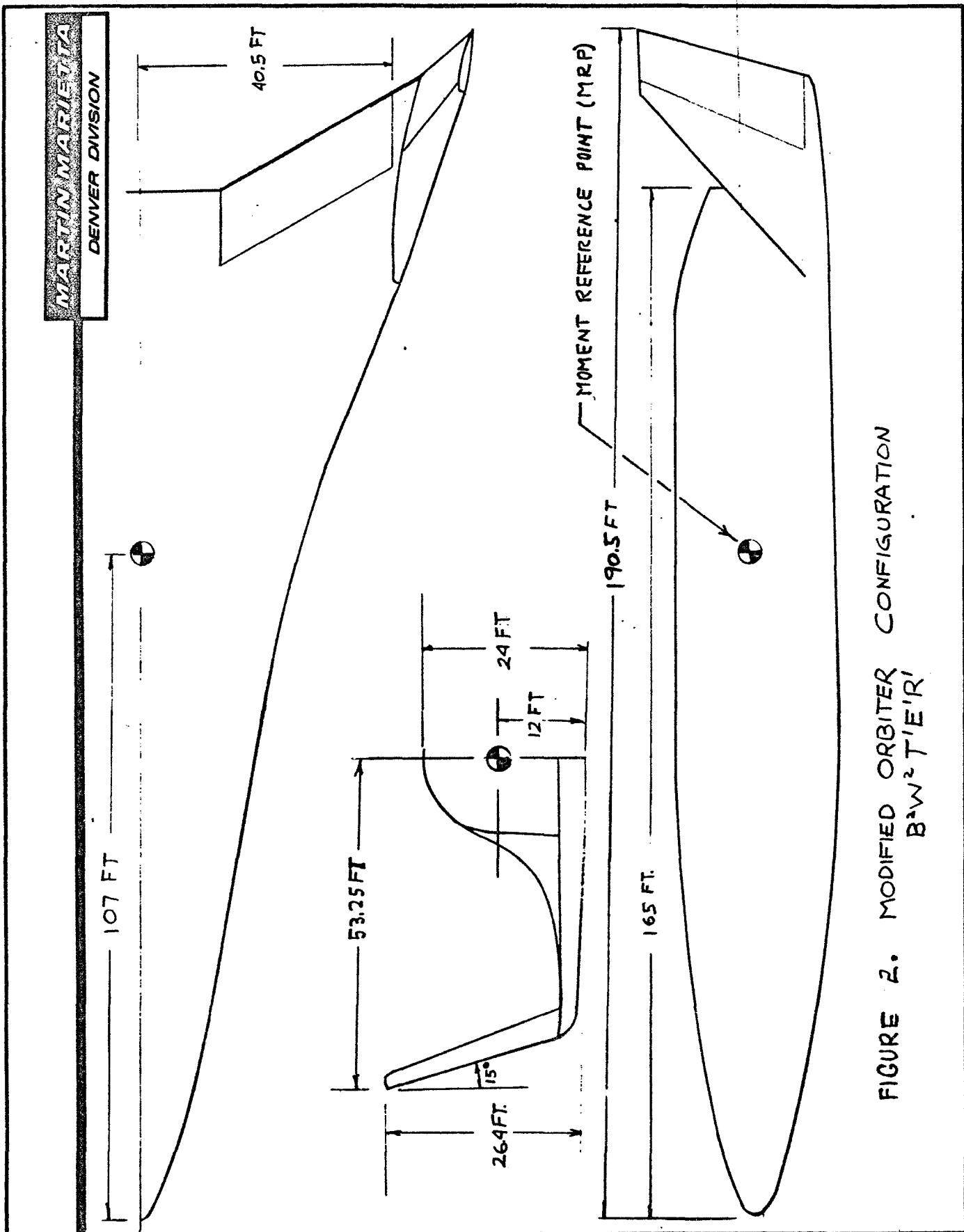


Figure 1. Axis systems, showing direction and sense of force and moment coefficients, angle of attack, and sideslip angle



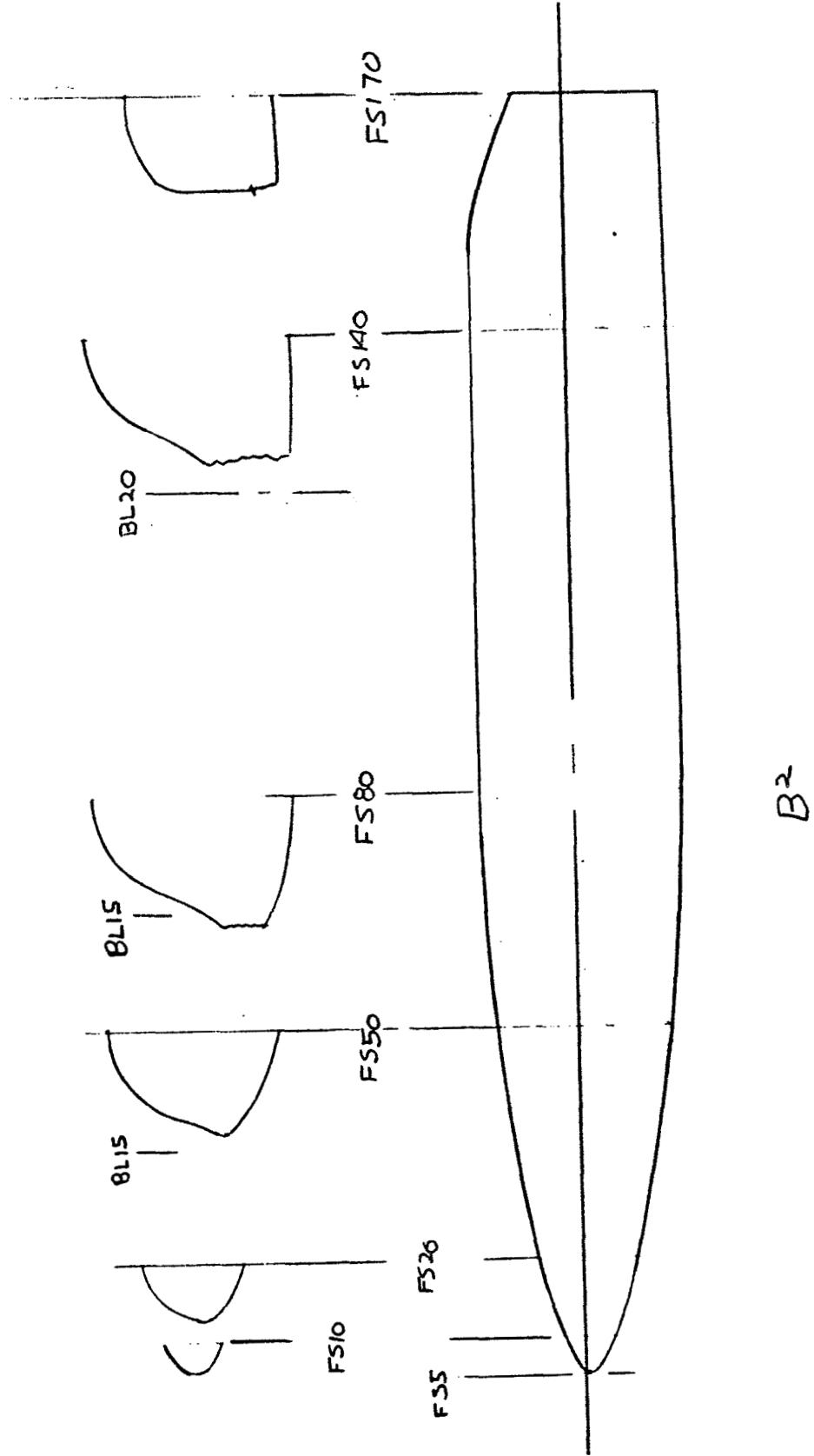


FIGURE 3. MODEL COMPONENT SKETCH

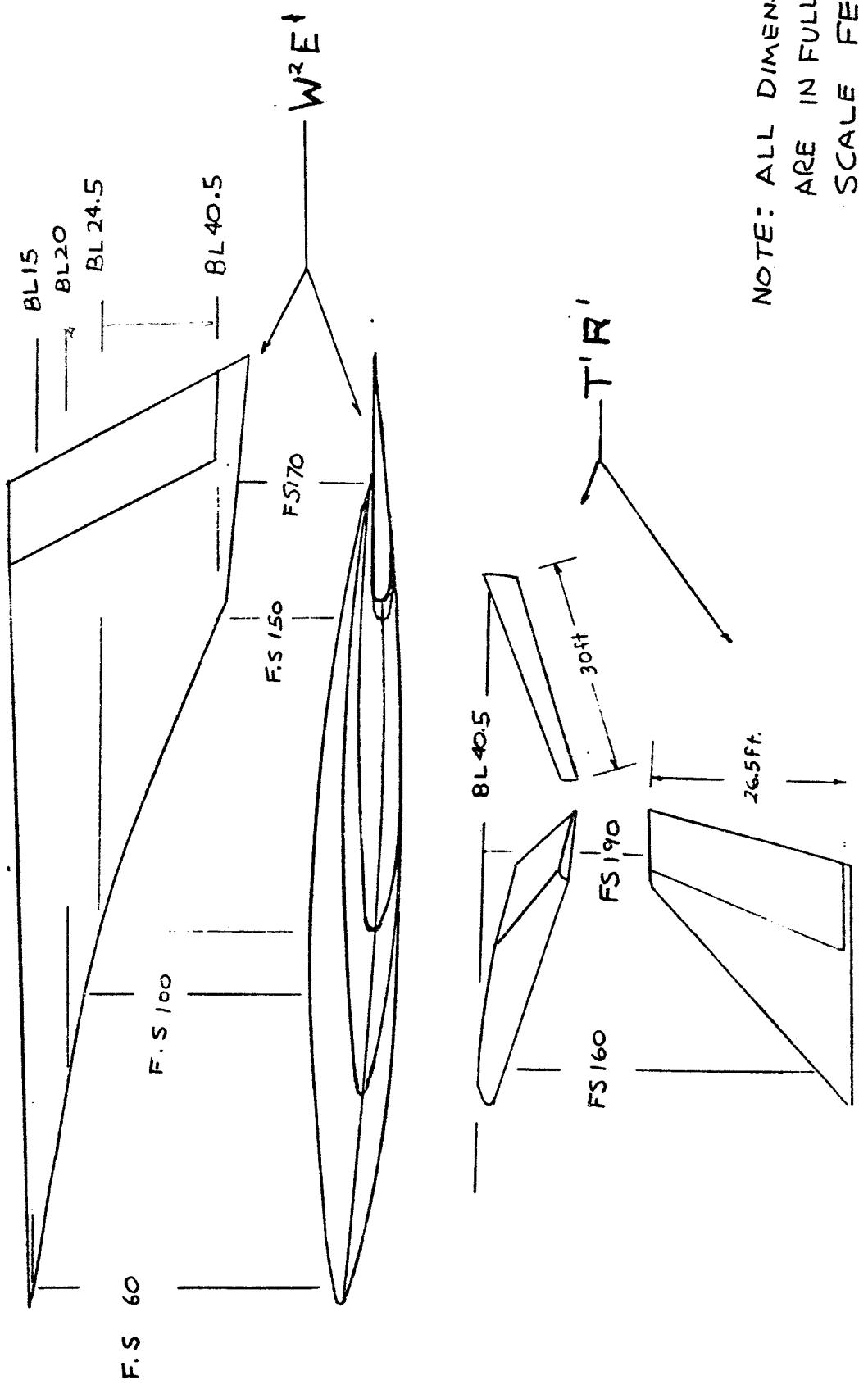


FIGURE 4. MODEL COMPONENT SKETCH

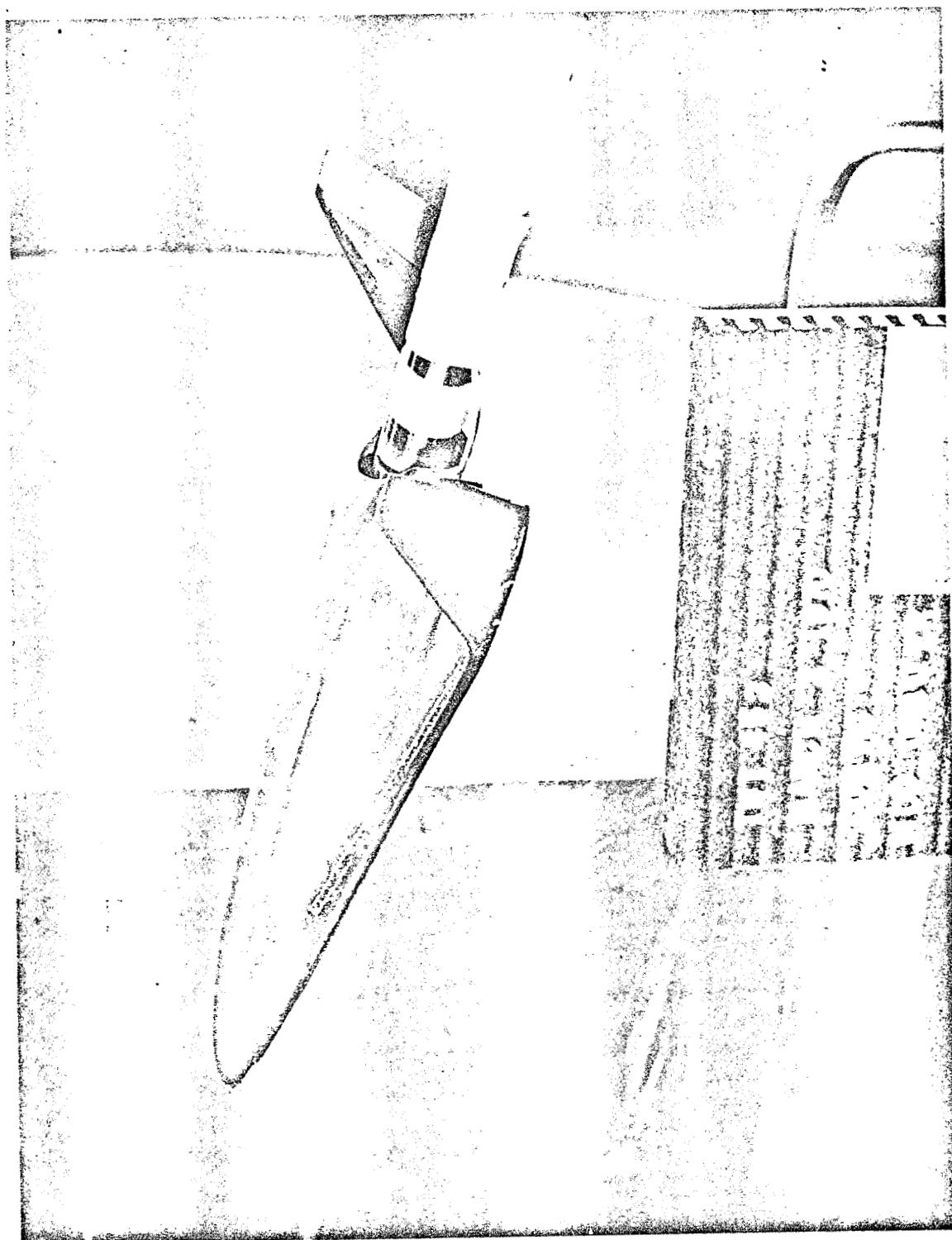


FIGURE 5. PHOTOGRAPH OF MODIFIED ORBITER CONFIGURATION (B2W2T1E1R1)

DATA DISPLAY INDEX

## DATA DISPLAY INDEX

### I. Single, Dependent Variable vs. Angle of Attack

<u>Data Set Identifier</u>	<u>Data Begins On Plot Page</u>
R17021	1
S17021	6
R17022	8
S17022	13
R17023	15
S17023	20
R17024	22
S17024	27
R17025	29
S17025	39
R17026	43
S17026	53
R17027	57
S17027	62
R17028	64
S17028	69
R17029	71
S17029	81

R Data Set Dependent Variables - CN, CNM, CAFORE, CABASE, L/D

S Data Set Dependent Variables - CL, CD

### II. Multiple, Dependent Variable vs. Angle of Attack

<u>Data Set Identifier</u>	<u>Mach Number</u>	<u>Data Begins On Plot Page</u>
R17021	0.4	85
S17021	0.4	90
B17024	0.4	92
T17024	0.4	97
C17024	0.8	99
U17024	0.8	104
D17025	1.0	106
V17025	1.0	111
E17024	1.2	113
W17024	1.2	118
F17024	2.74	120
X17024	2.74	125
G17025	3.48	127
Y17025	3.48	132
H17024	4.95	134
Z17024	4.95	139

- | <u>Data Set Type</u>      | <u>Dependent Variables</u>   |
|---------------------------|------------------------------|
| 1) R, B, C, D, E, F, G, H | CN, CNM, CAFORE, CABASE, L/D |
| 2) S, T, U, V, W, X, Y, Z | CL, CD                       |

### III. Single, Dependent Variable Cross-Plots

<u>Data Set Identifier</u>	<u>Data Begins On Plot Page</u>
R17021	141
S17021	142
R17022	144
S17022	145
R17023	147
S17023	148
R17024	150
S17024	151
R17025	153
S17025	155
R17026	159
S17026	161
R17027	165
S17027	166
R17028	168
S17028	169
R17029	171
S17029	173

R Data Set Dependent Variables - CN vs. CNM

S Data Set Dependent Variables - CD vs. CL, CNM vs. CL

### IV. Multiple, Dependent Variable Cross-Plots

<u>Data Set Identifier</u>	<u>Mach Number</u>	<u>Data Begins On Plot Page</u>
R17021	0.4	177
S17021	0.4	178
B17024	0.4	180
T17024	0.4	181
C17024	0.8	183
U17024	0.8	184
D17025	1.0	186
V17025	1.0	187
E17024	1.2	189
W17024	1.2	190
F17024	2.74	192
X17024	2.74	193
G17025	3.48	195
Y17025	3.48	196
H17024	4.95	198
Z17024	4.95	199

#### Data Set Type                   Dependent Variables

- 1) R, B, C, D, E, F, G, H  
 2) S, T, U, V, W, X, Y, Z

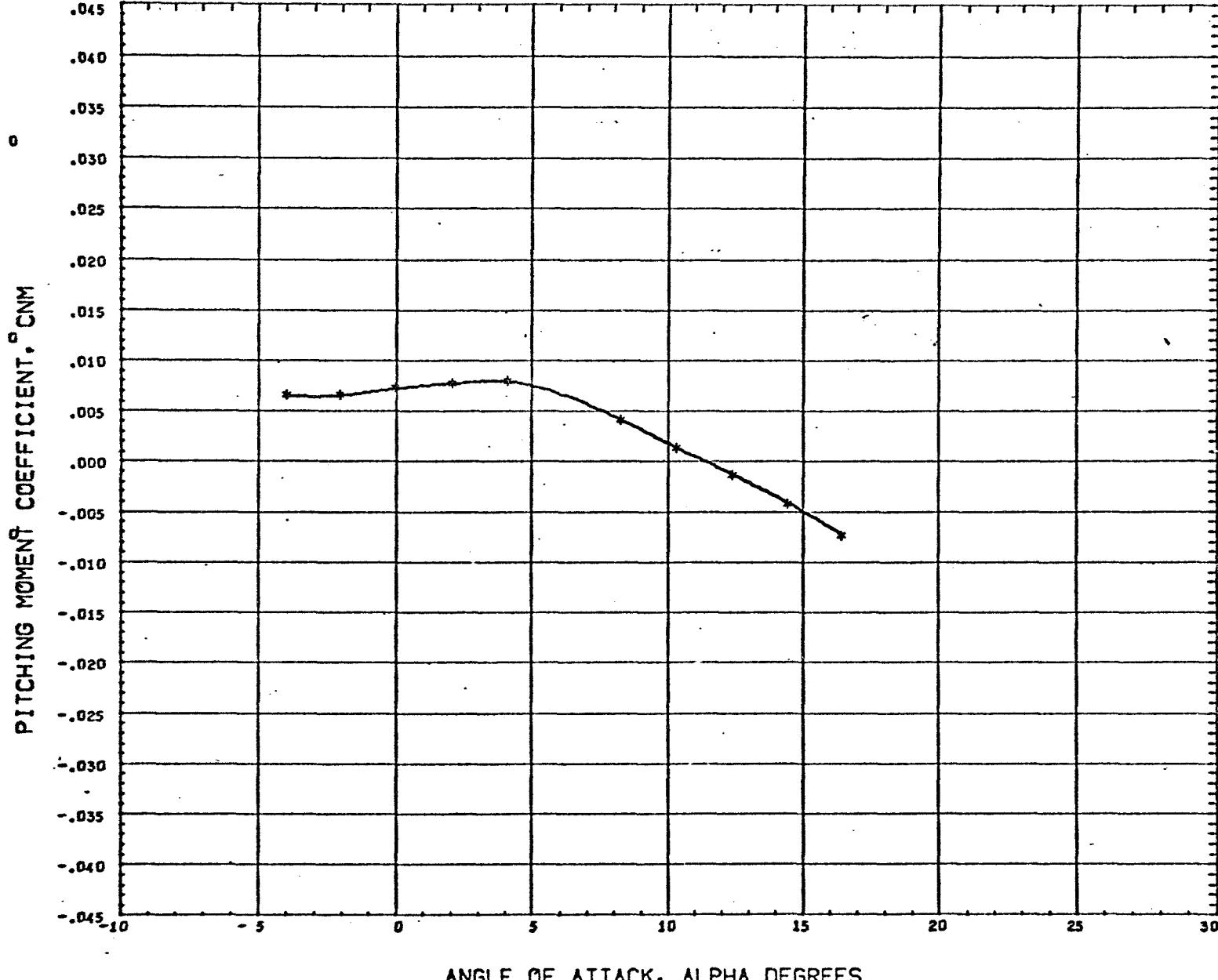
CN vs CNM  
 CD vs CL, CNM vs CL

## DATA

### NOTE:

Data plots are presented with faired lines between data points. However, where the independent variable was not a continuously increasing function, or where the magnitudes of individual data points resulted in irregular fairings, straight lines between data points were substituted. It should also be noted that for some subsonic test conditions both the forebody axial force coefficient, CAFOR, and the base axial force coefficient, CABASE, were negative.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 \* 0.396 BETA 0.000 ELEVON 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.495 FT.  
 XHRF 0.406  
 YHRF 0.000  
 ZHRF 0.045

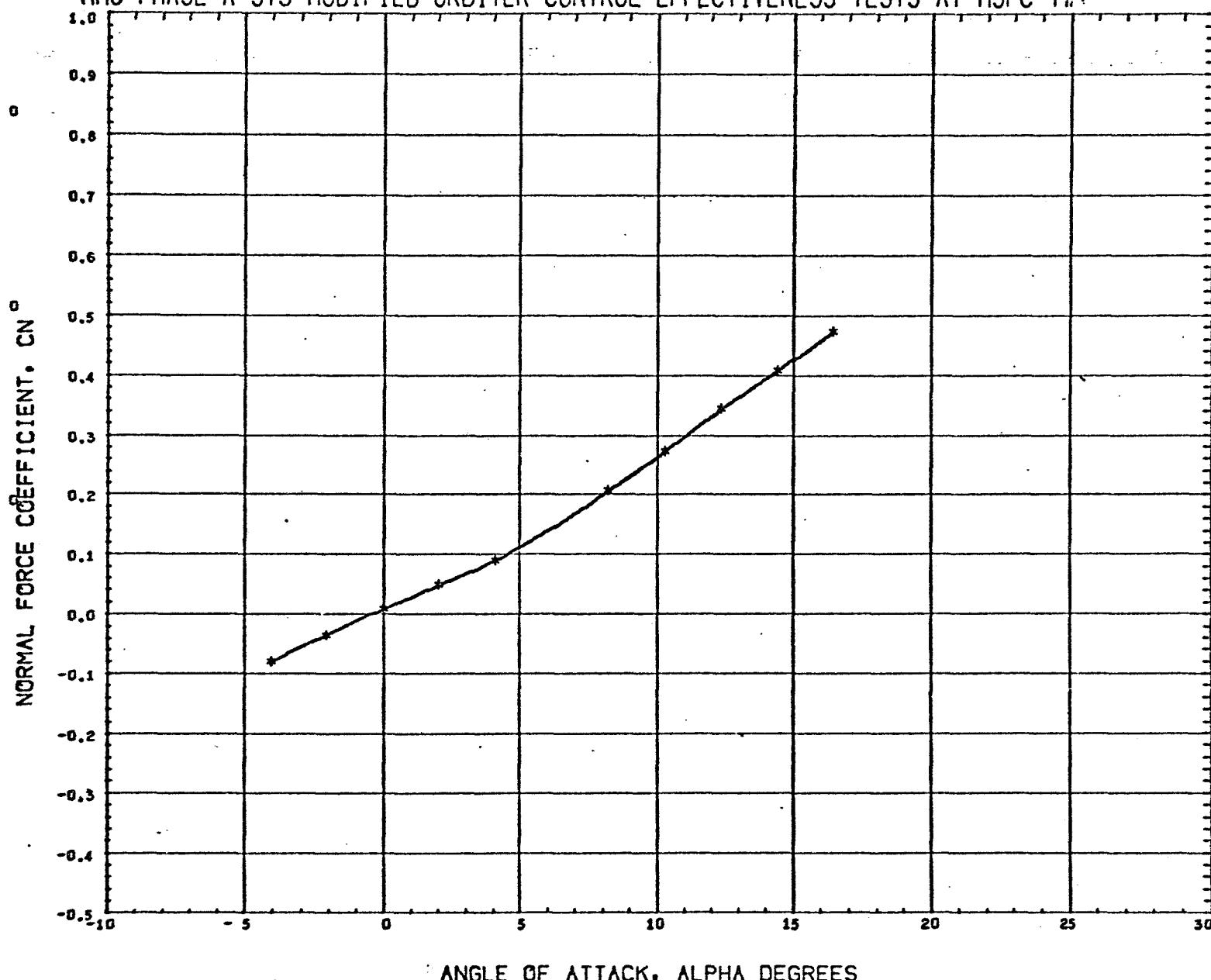
REFERENCE FILE.

\*MSFC 453 MMC MOD ORB B2W2E1 DEL E0

(R17021) 02 JUL 70 PAGE

1

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 0.396 BETA 0.000 ELEVON 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XMRF 0.406  
 YMRF 0.000  
 ZMRF 0.045

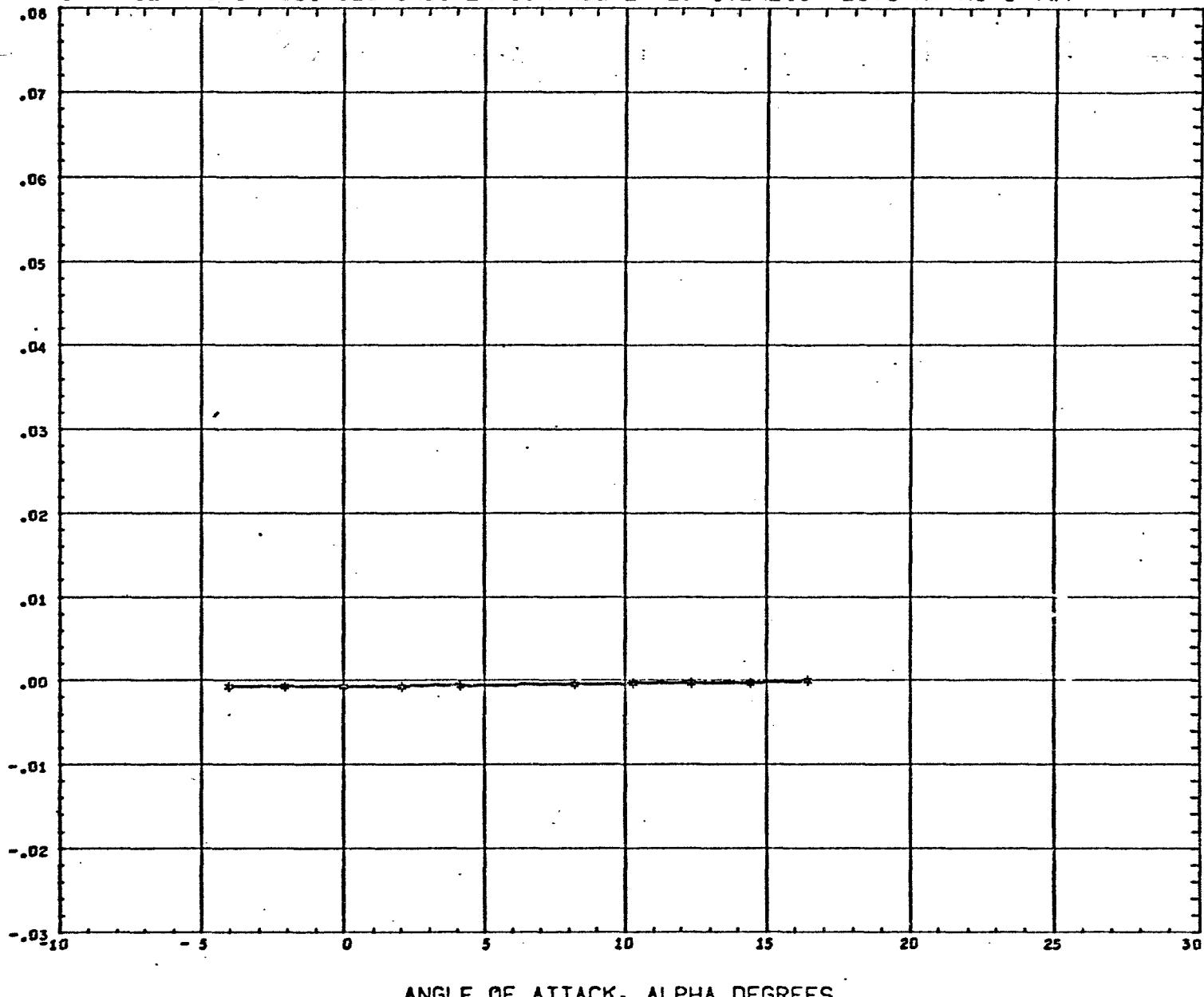
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MSFC 453 MMC MOD ORB B2W2E1 DEL E0

(R17021) 02 JUL 70 PAGE 2

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, C<sub>A,BASE</sub>



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 0.396 BETA 0.000 ELEVON 0.000

REFERENCE INFORMATION  
REFS 0.116 SQ.FT.  
REFL 0.646 FT.  
REFB 0.405 FT.  
XHRF 0.406  
YHRF 0.000  
ZHRF 0.045

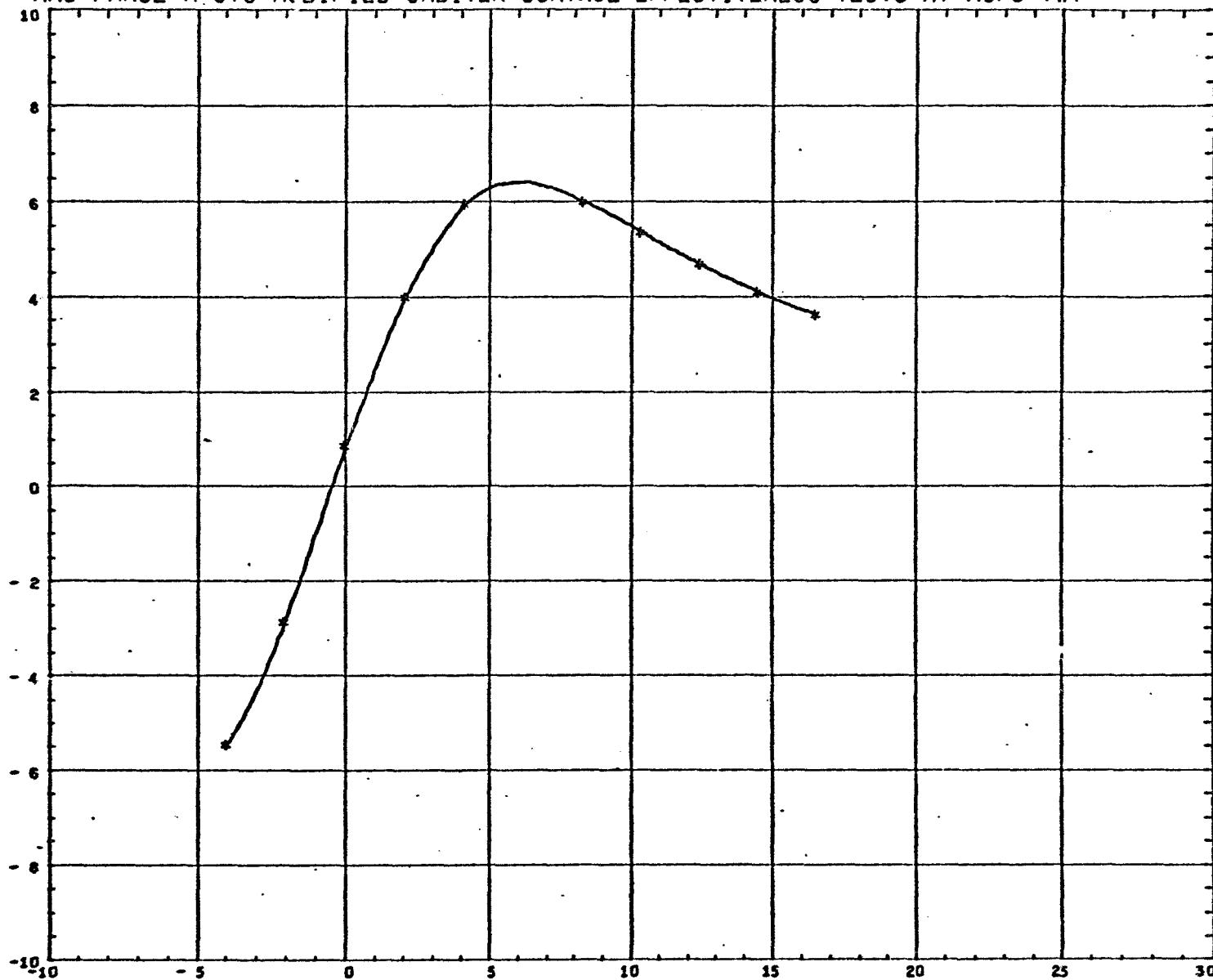
REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E0

(R17021) 02 JUL 70 PAGE 3

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

LIFT-DRAG RATIO, L/D



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH BETA PARAMETRIC VALUES  
\* 0.396 0.000 ELEVON 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E0

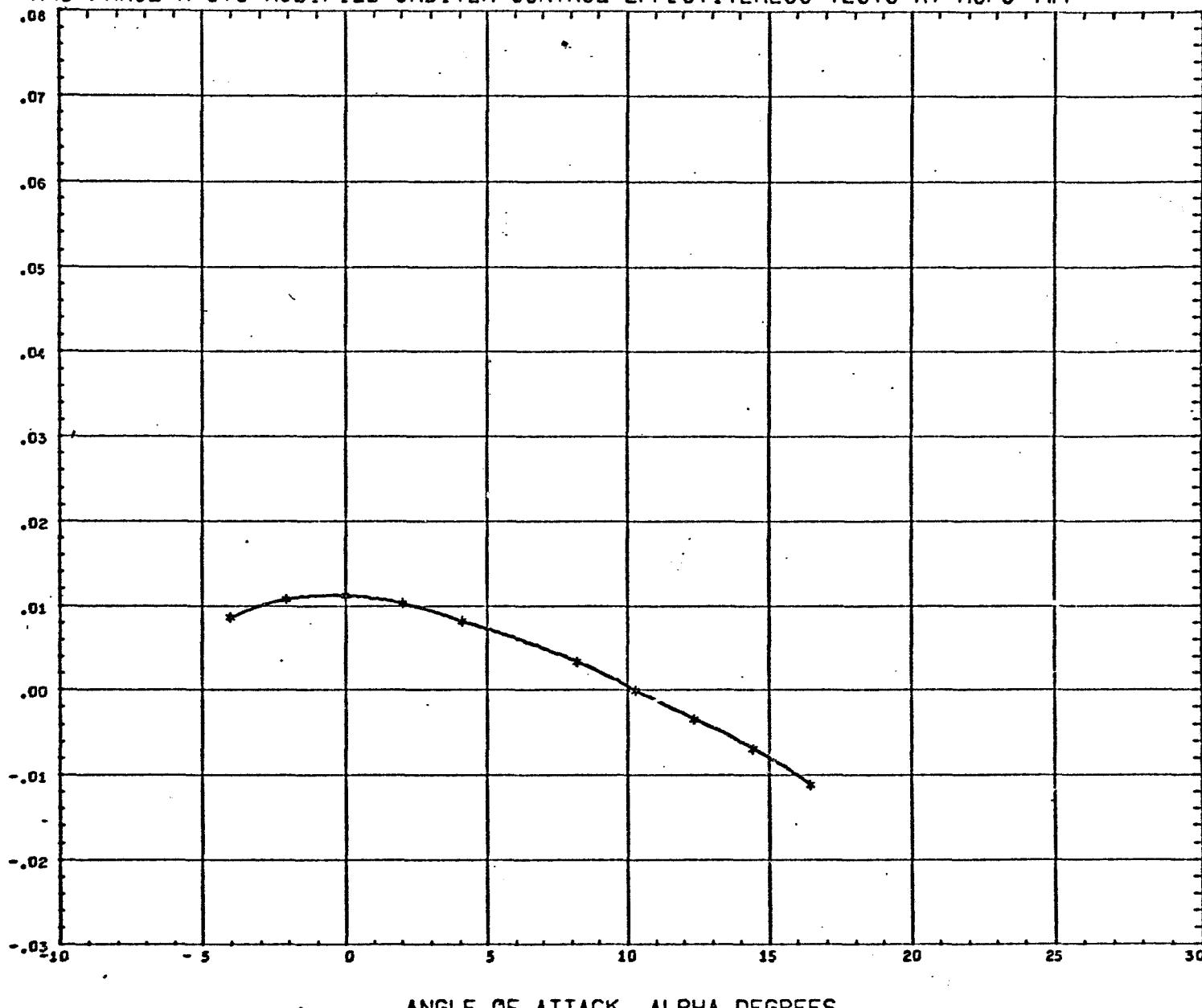
(R17021) 02 JUL 70

PAGE

4

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CA/ORE



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 0.396 BETA 0.000 ELEVON 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.406  
 YHRF 0.000  
 ZHRF 0.045

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E0

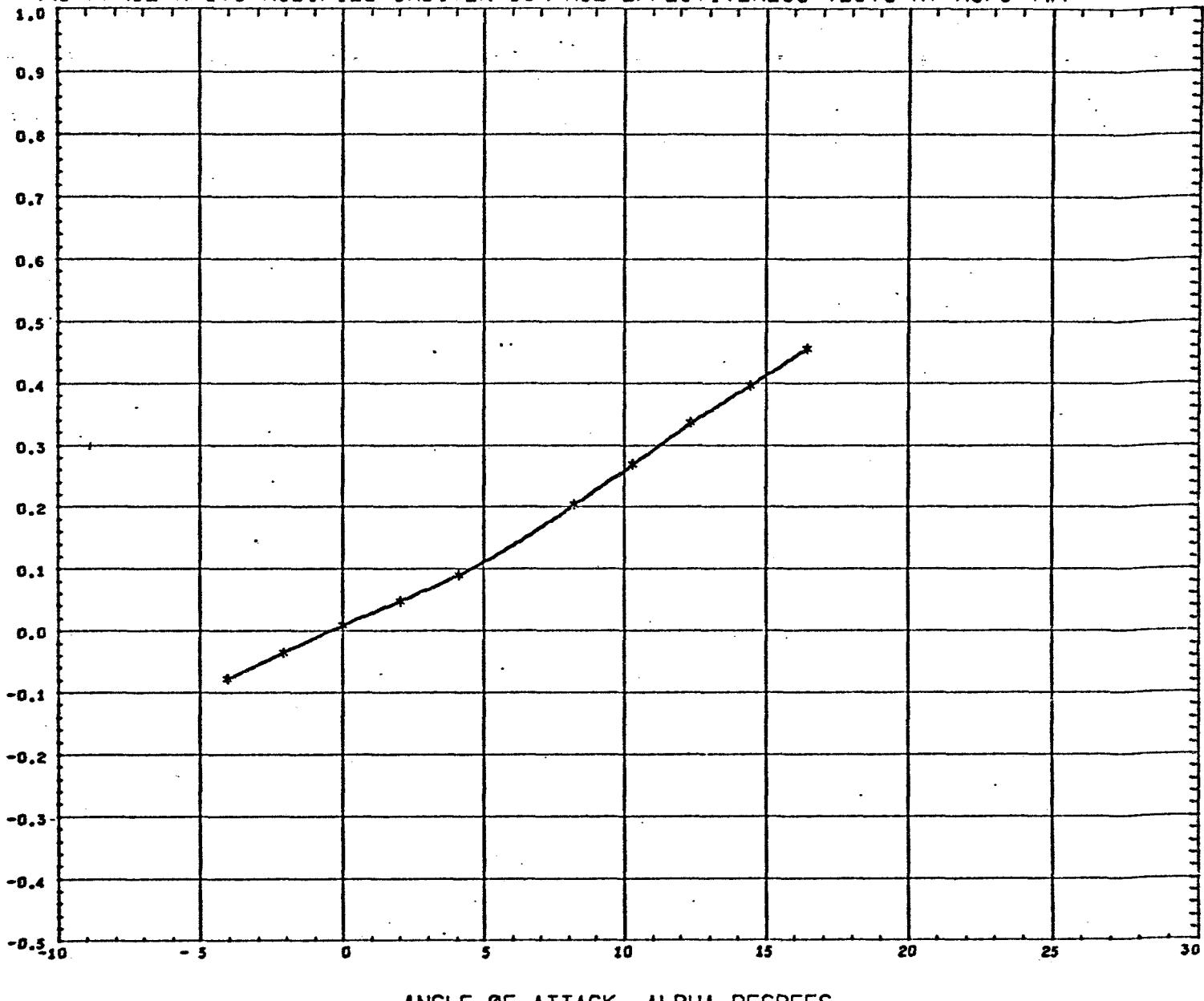
(R17021) 02 JUL 70

PAGE

5

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

LIFT COEFFICIENT. CL



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
● 0.396 BETA 0.000 ELEVON 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.009	
ZHRF	0.045	

REFERENCE FILE.

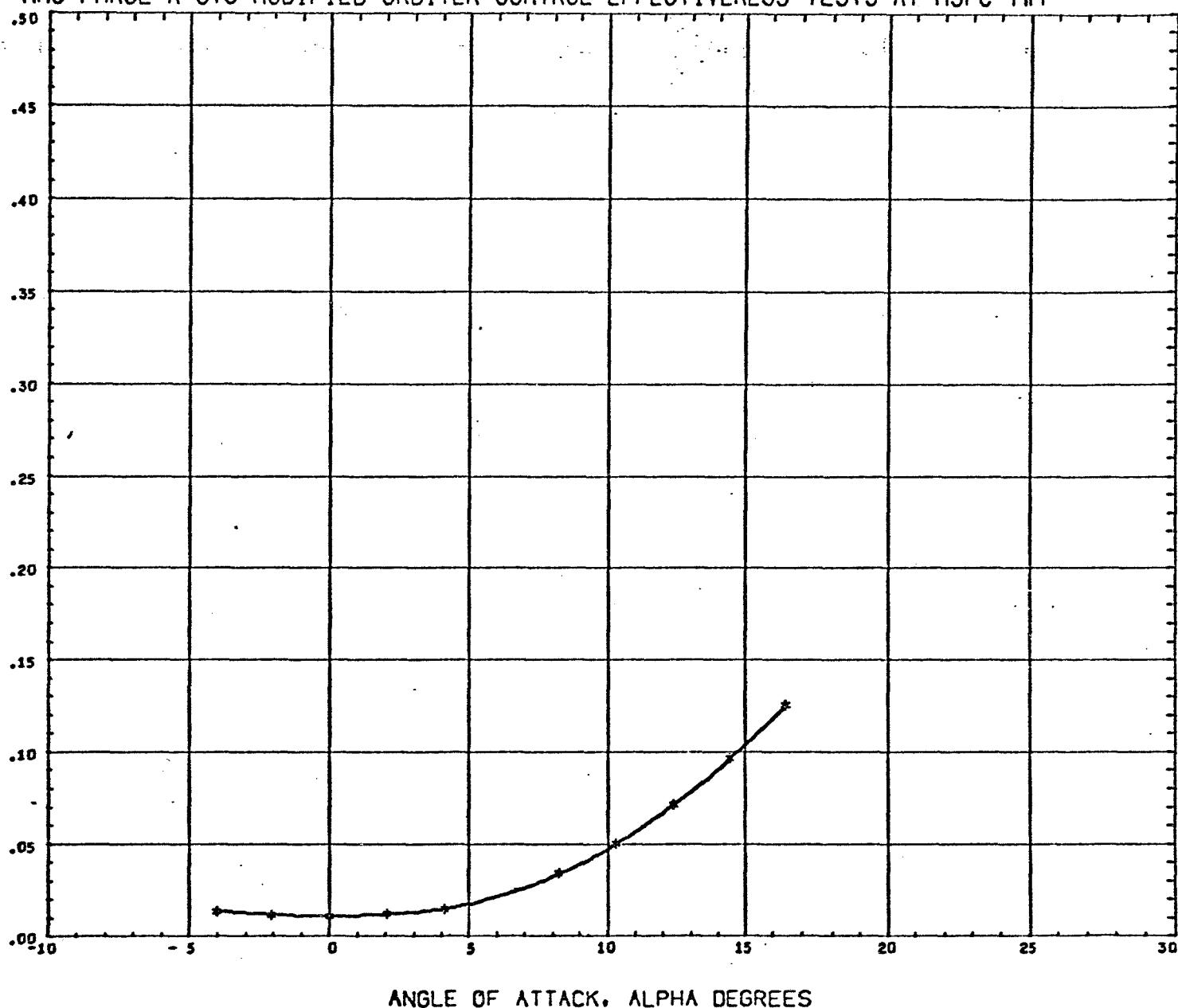
MSFC 453 MMC MOD ORB B2W2E1 DEL E0

(S17021) 02 JUL 70 PAGE

6

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT, CD



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 0.396 BETA 0.000 ELEVON 0.000

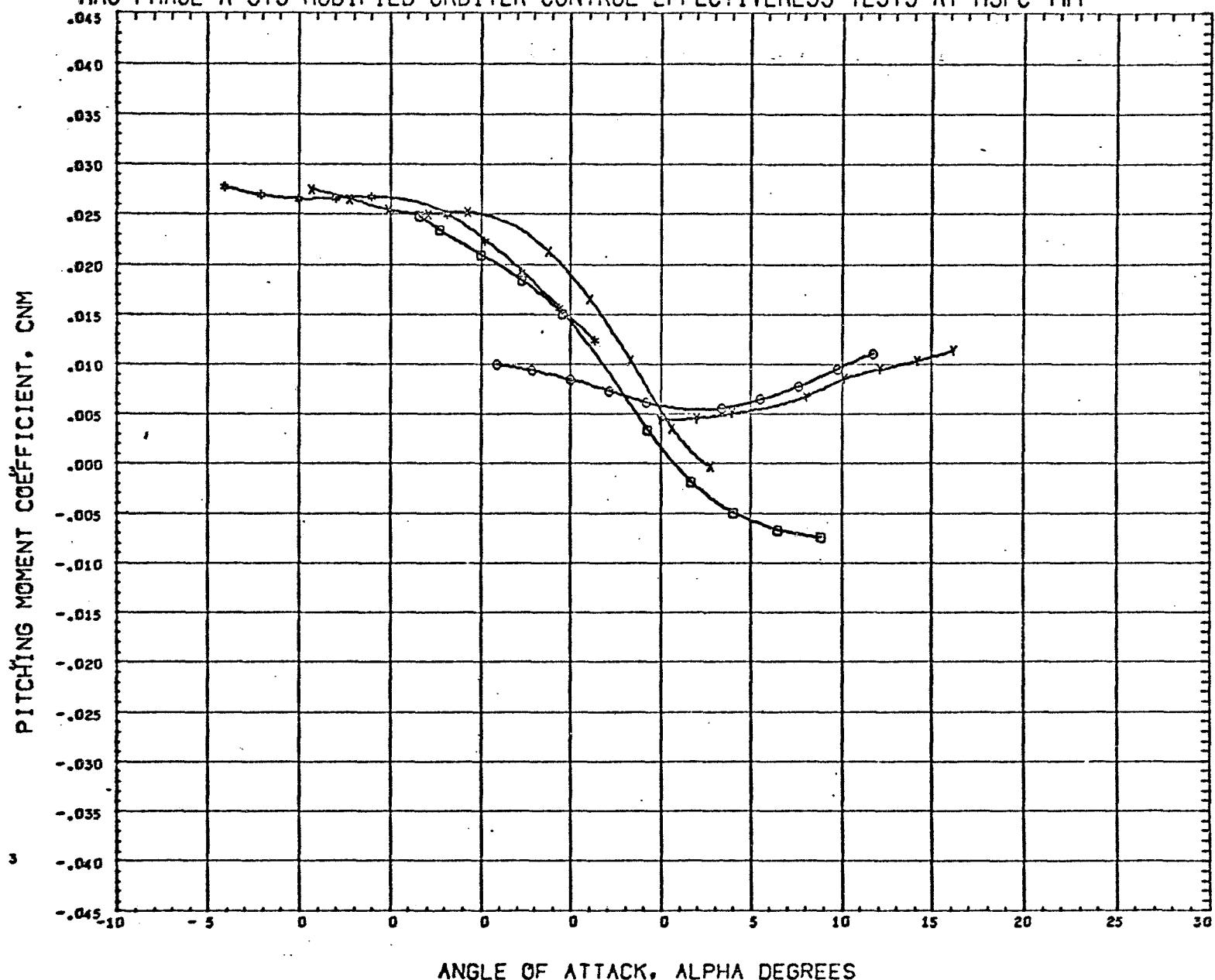
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REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.496	
YNRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E0

(S17021) 02 JUL 70 PAGE 7

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



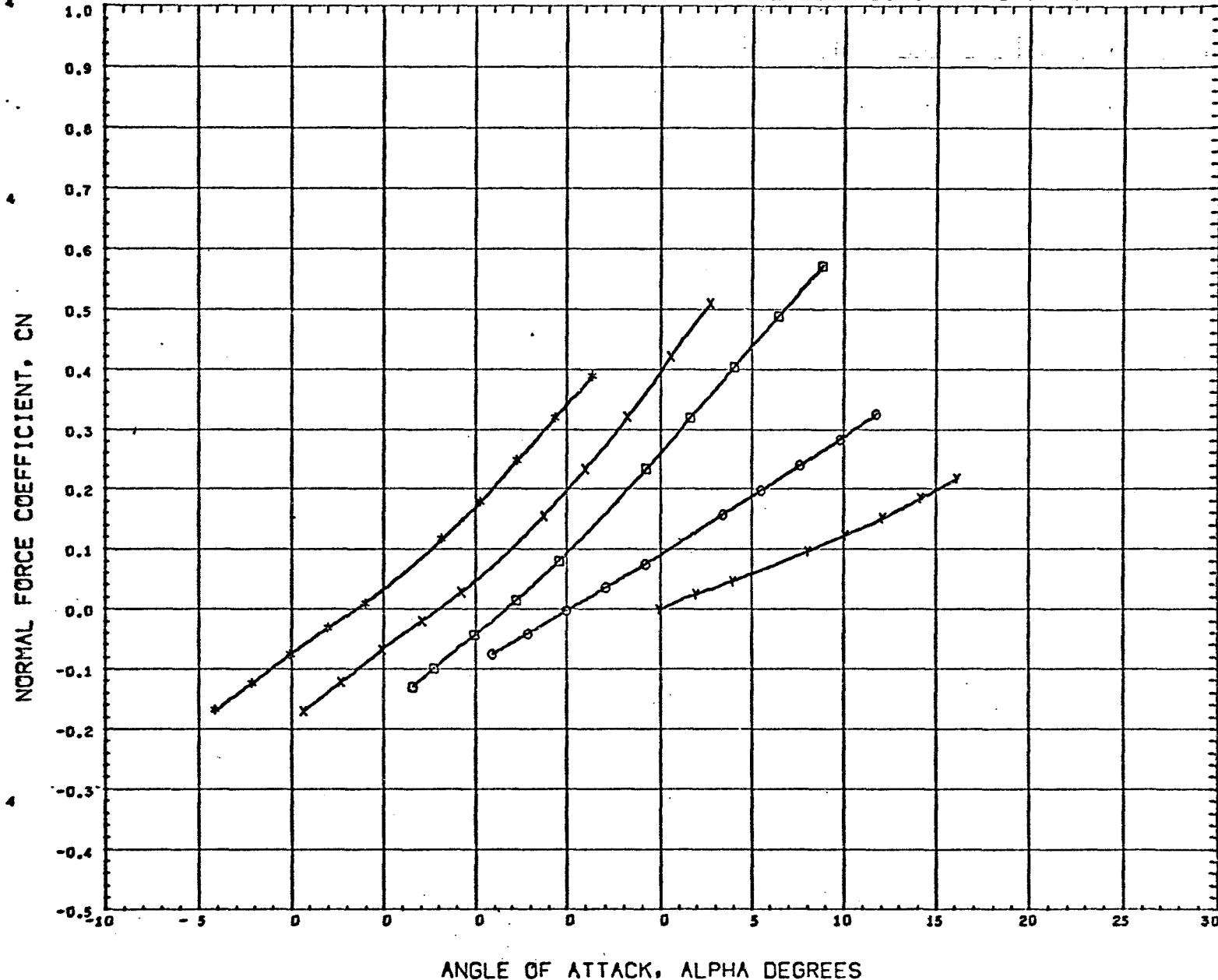
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.397		0.000 ELEVON - 15.000
X	0.797		
3	1.199		
G	2.745		
T	4.960		

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	HACH	BETA	PARAMETRIC VALUES		
*	0.397		0.000	ELEVON	- 15.000
x	0.797				
G	1.199				
O	2.740				
T	4.960				

REFERENCE INFORMATION		
REFS	0.116	SQ.F.T.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZKRF	0.045	

**REFERENCE FILE.**

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

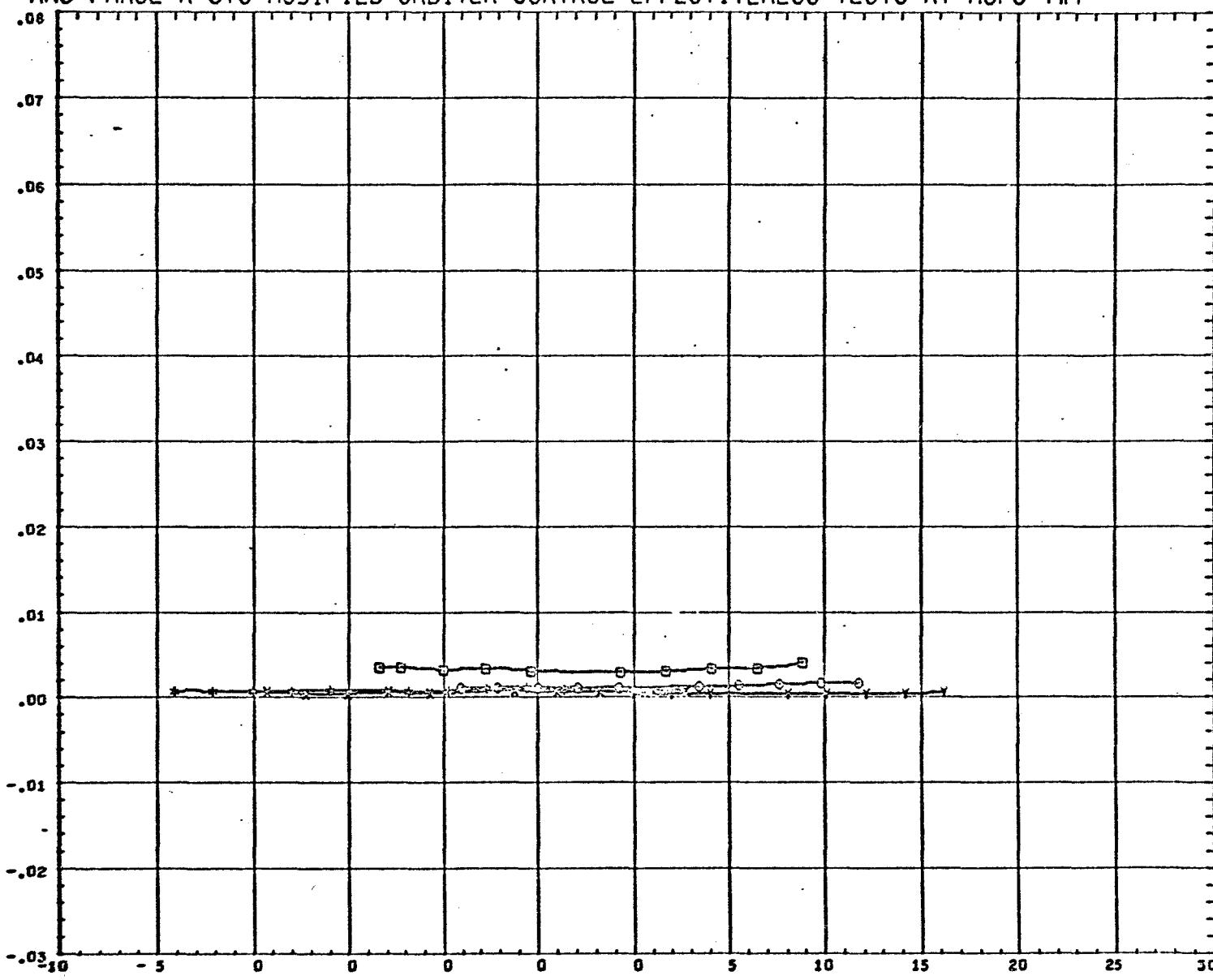
(R17022) 02 JUL 70

PAGE

9

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, C<sub>A,BASE</sub>



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.397		0.000 ELEVON - 15.000
X	0.797		
G	1.199		
O	2.745		
Y	4.965		

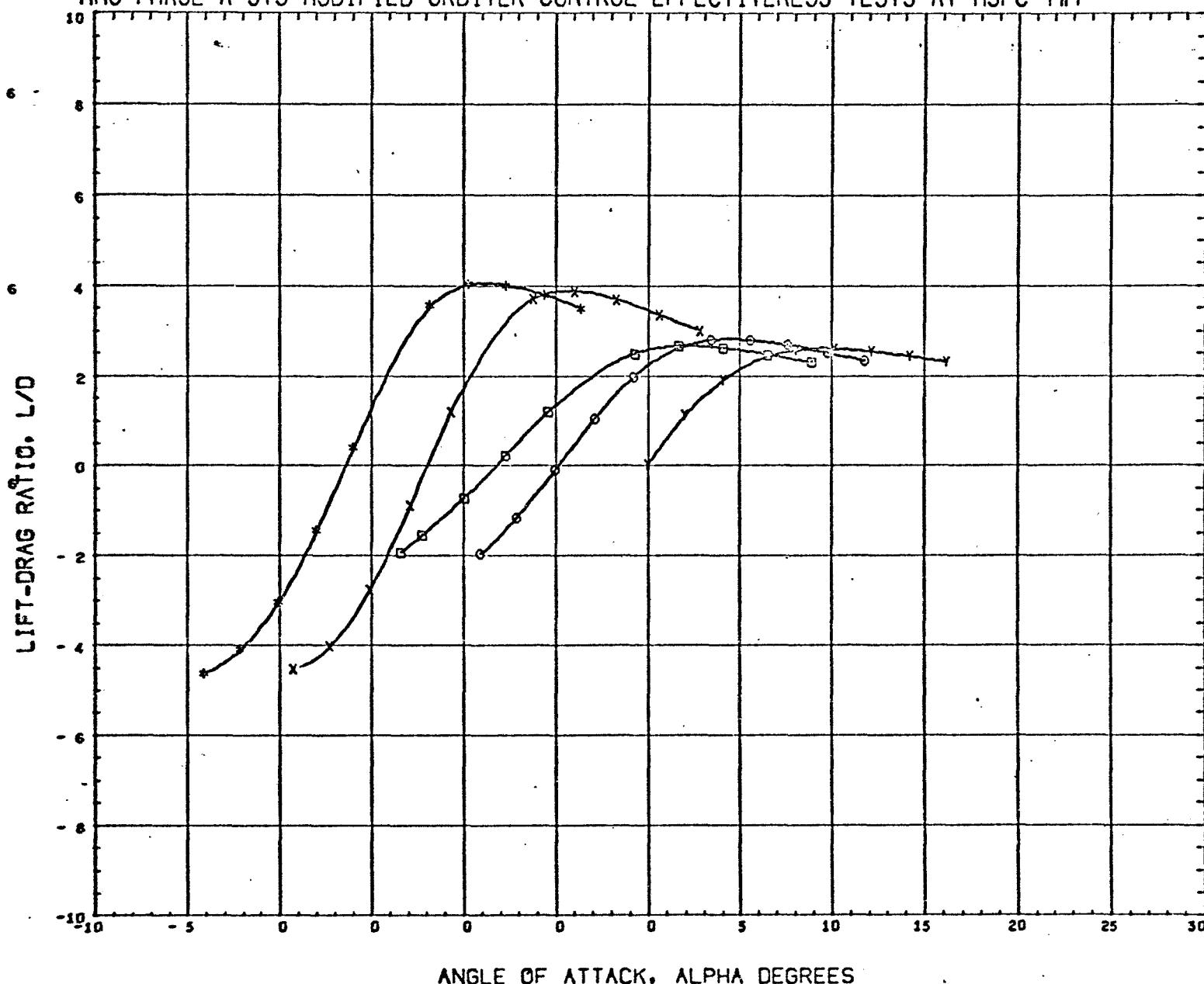
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REFERENCE INFORMATION		
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REFL	0.645	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

\* MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(R17022) 02 JUL 70 PAGE 10

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

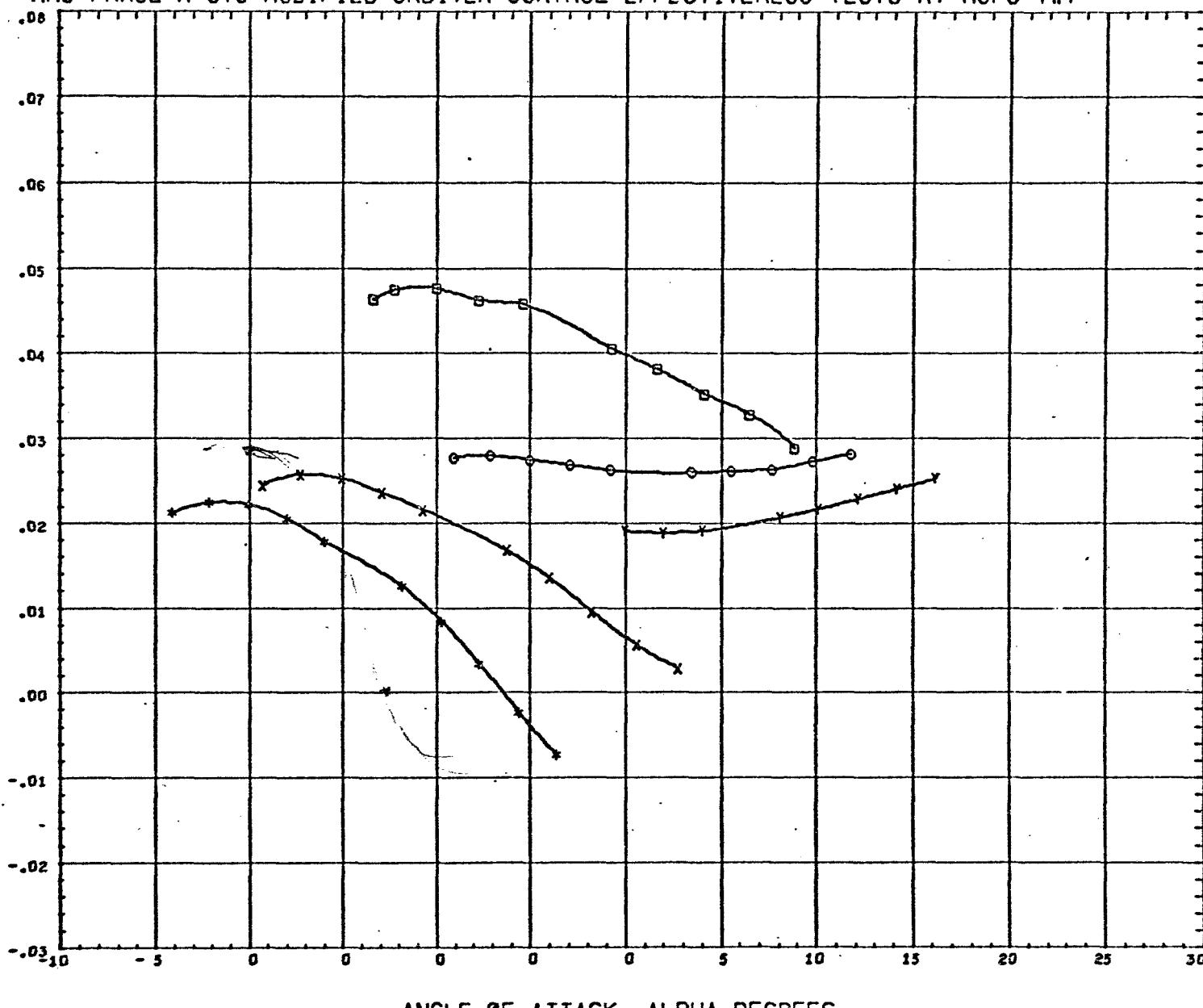
SYMBOL	MACH	BETA	PARAMETRIC VALUES	
*	0.397		0.000	ELEVON - 15.000
x	0.797			
o	1.199			
□	2.740			
▽	4.960			

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAFOR<sup>7</sup>



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.397	0.000	ELEVON - 15,000
X	0.797		
G	1.199		
O	2.740		
Y	4.960		

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

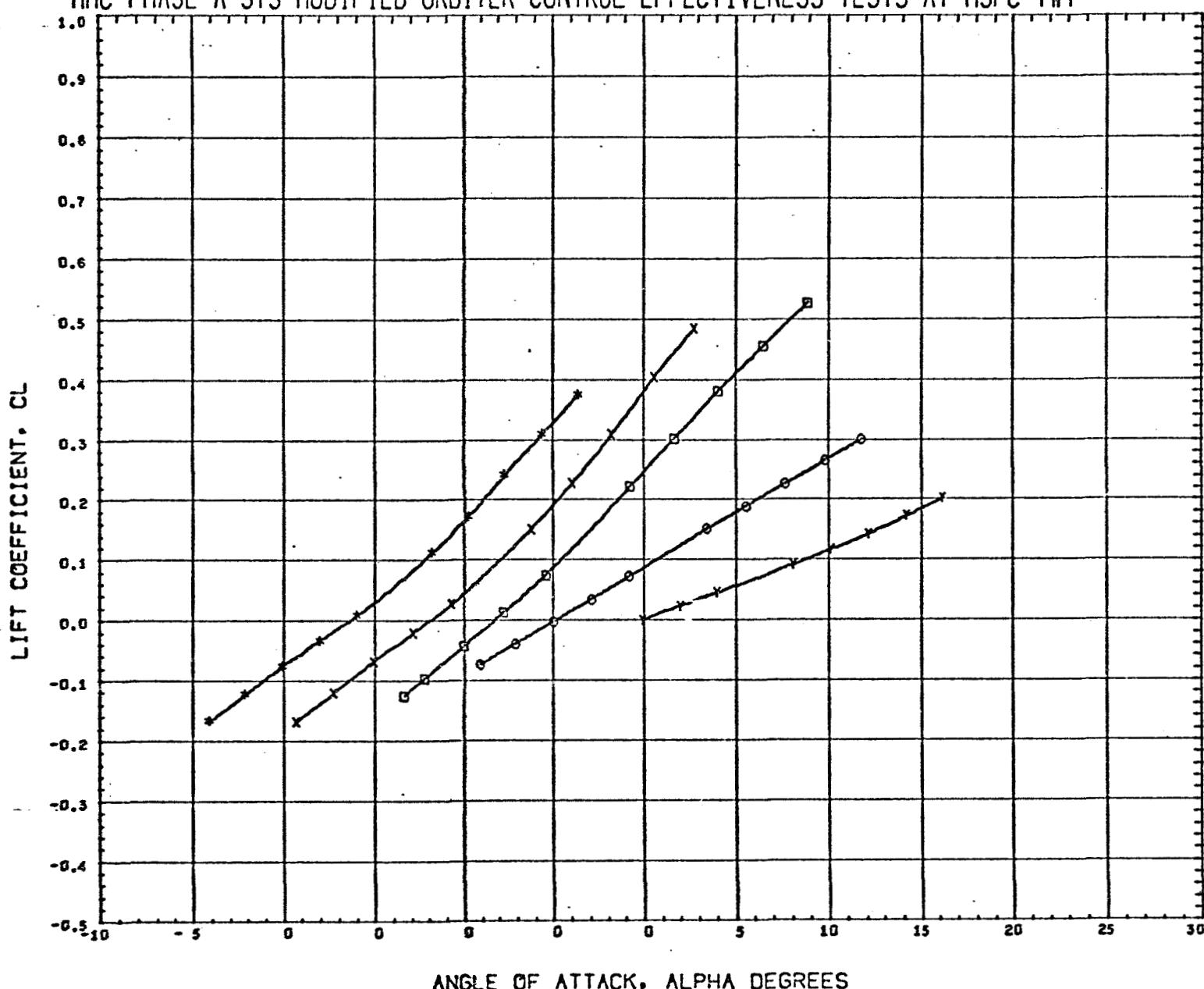
(R17022) 02 JUL 70

PAGE

12

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REF8	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH	PARAMETRIC VALUES		
*	0.397	BETA	0.000	ELEVON - 15,000
x	0.797			
o	1.199			
o	2.740			
x	4.960			

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

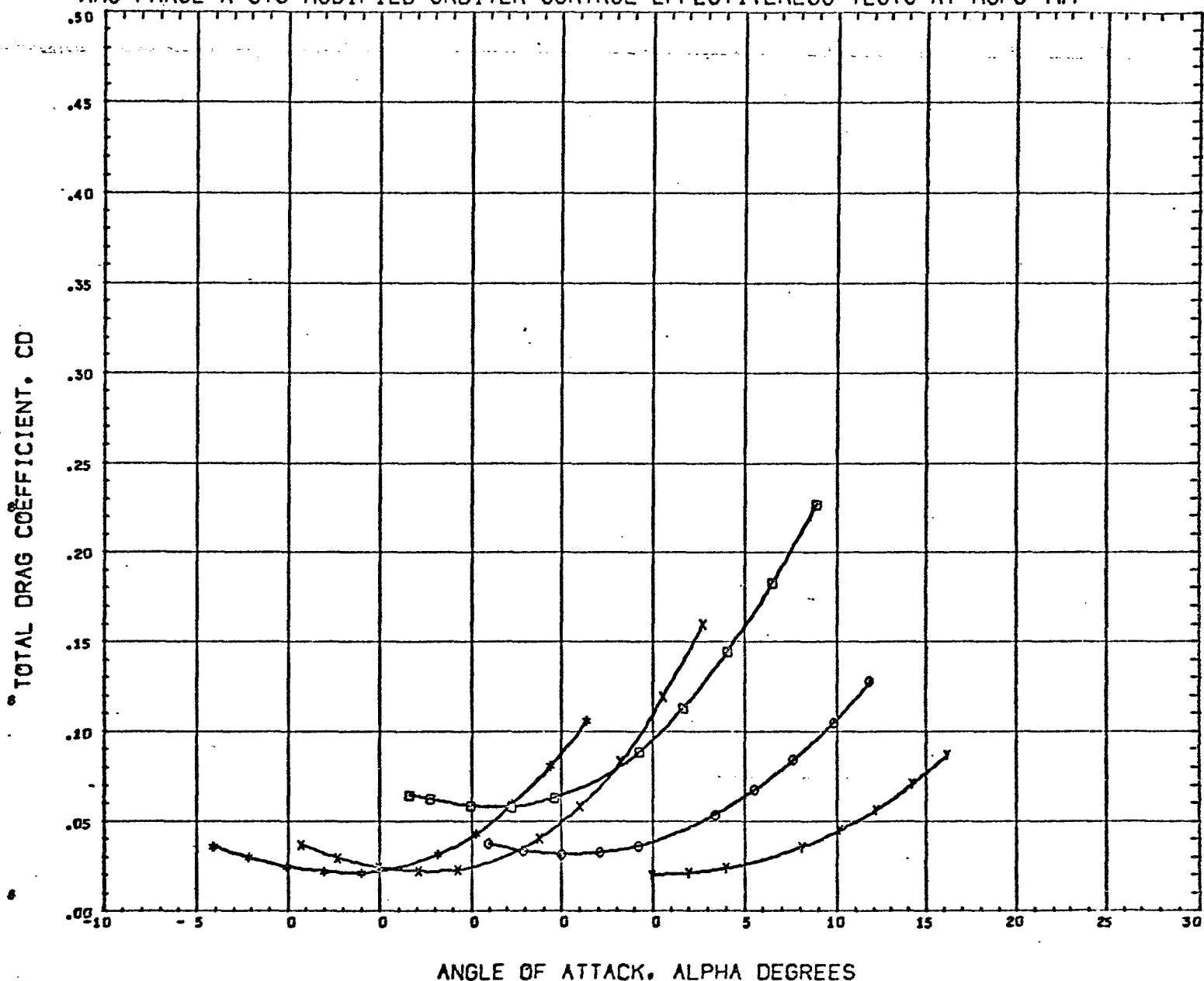
MSEC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(S17022) 02 JUL 70

PAGE

13

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH	PARAMETRIC VALUES		
•	0.397	BETA	0.999	ELEVON - 15,000
x	0.797			
□	1.199			
○	2.740			
×	4.960			

**REFERENCE FILE.**

REFERENCE INFORMATION		
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REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.405	
YHRF	0.000	
ZHRF	0.045	

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

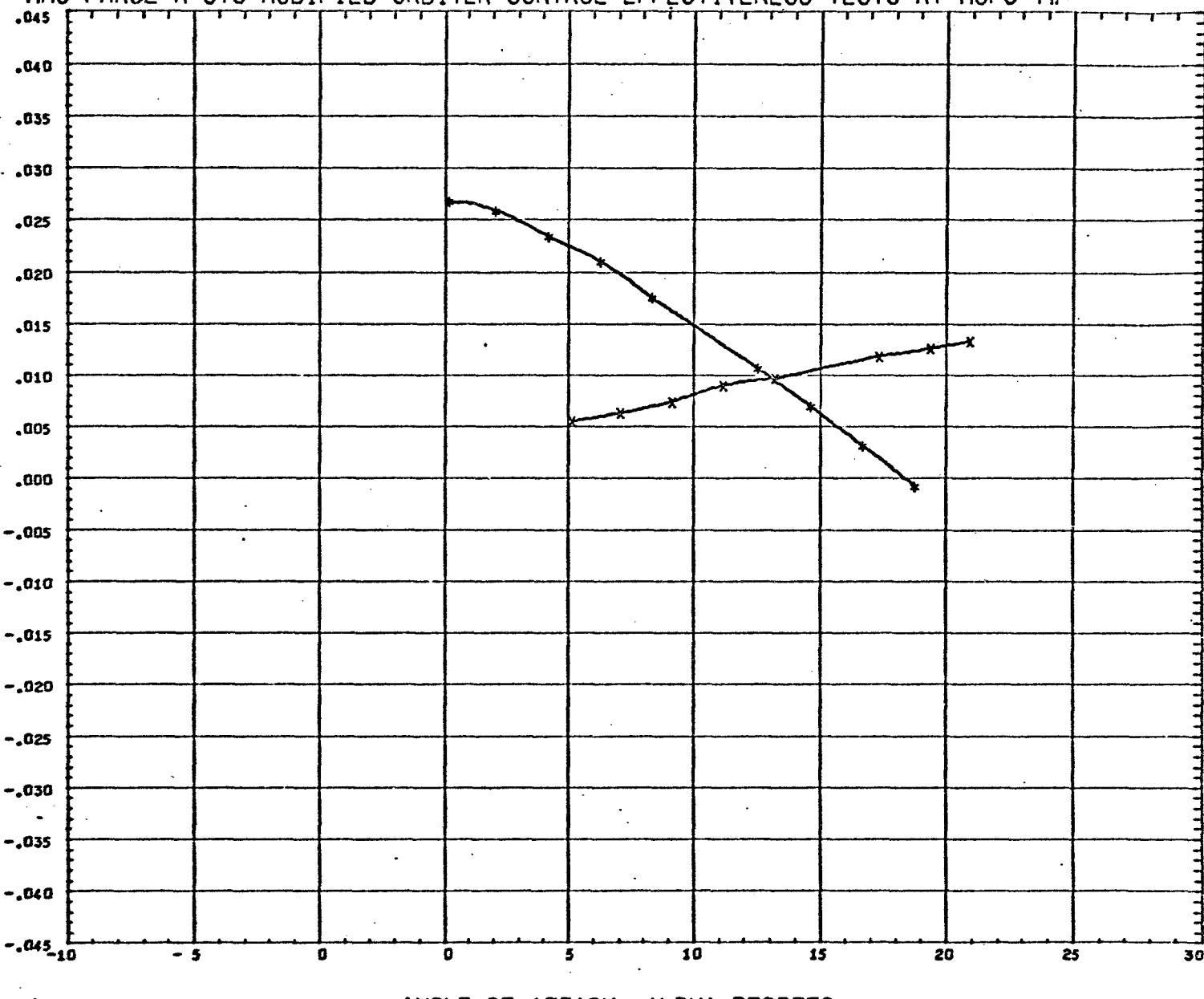
(S17022) 02 JUL 70

PAGE

14

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 \* 0.395 BETA 0.000 ELEVON - 15.000  
 x 4.960

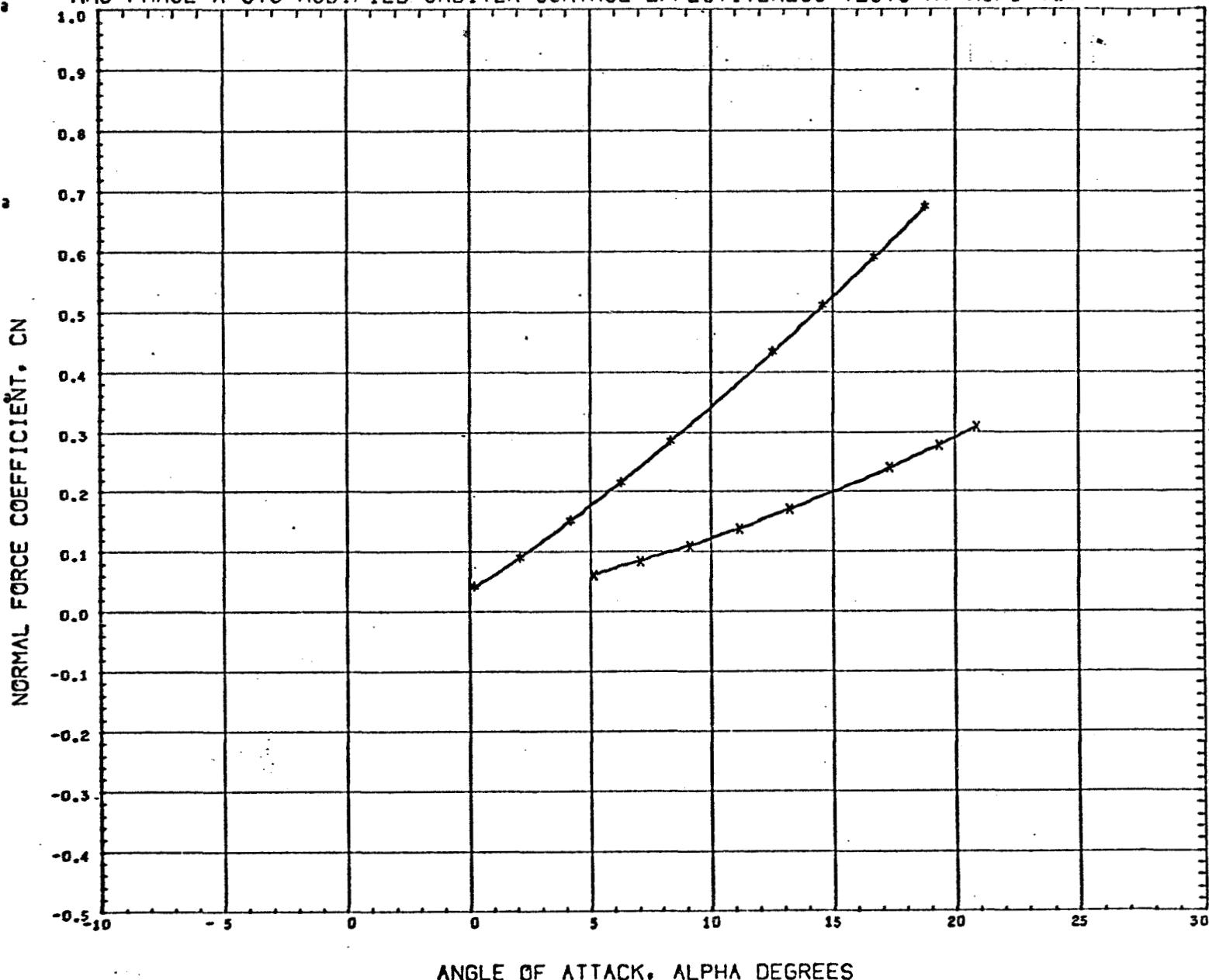
REFERENCE INFORMATION  
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 REFL 0.646 FT.  
 REFb 0.405 FT.  
 XHRF 0.406  
 YHRP 0.000  
 ZHRF 0.045

REFERENCE FILE.

MSFC 453 MMC MOD CRB B2W2E1 DEL E-15 R0

(R17023) 02 JUL 70 PAGE 15

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



<b>SYMBOL</b>	<b>MACH</b>	<b>BETA</b>	<b>PARAMETRIC VALUES</b>
*	0.395		0.000 ELEVON - 15.000
x	4.965		

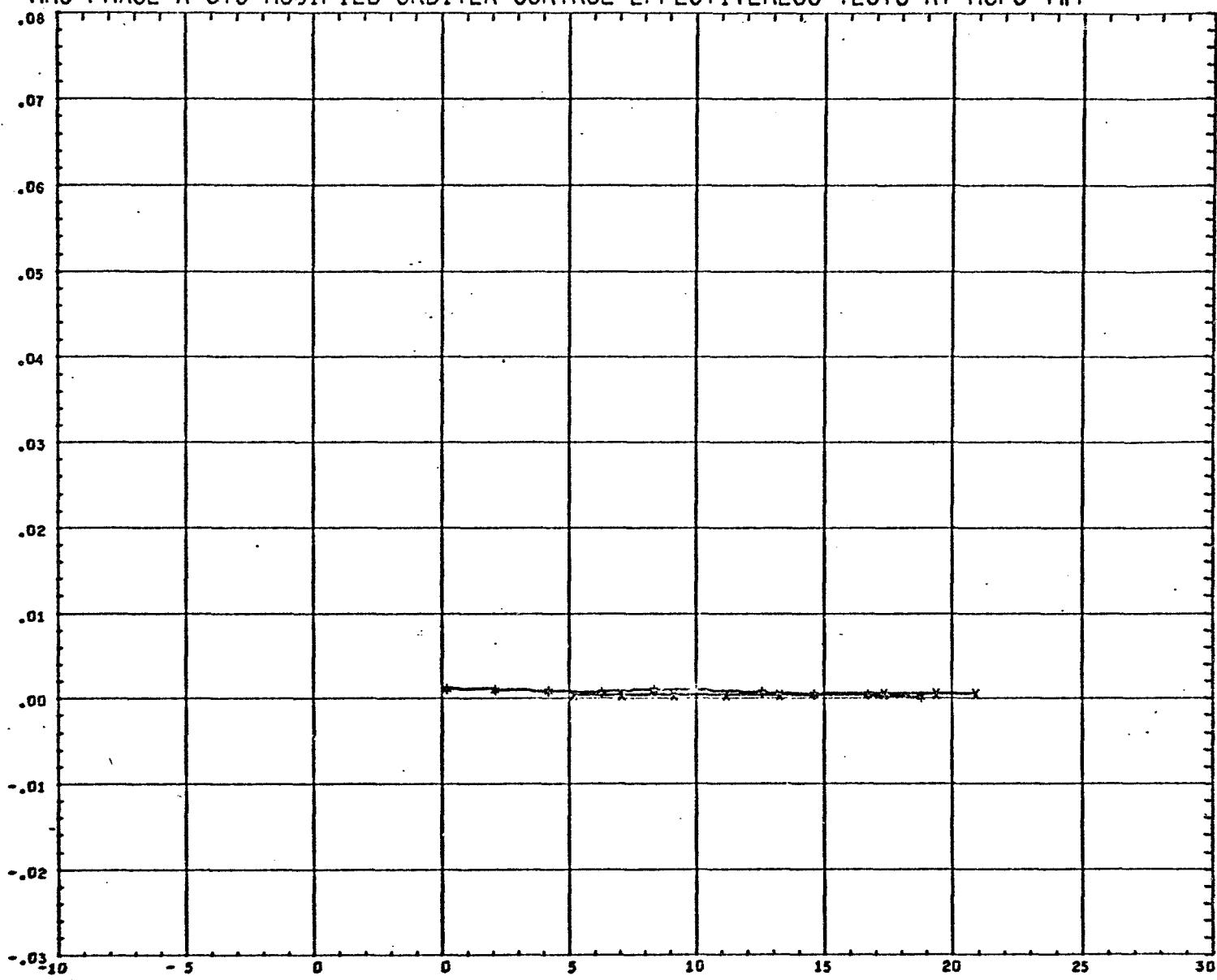
REFERENCE INFORMATION		
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REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(R17023) 02 JUL 70 PAGE 16

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK, ALPHA DEGREES**

<b>SYMBOL</b>	<b>MACH</b>	<b>BETA</b>	<b>PARAMETRIC VALUES</b>
*	0.395		0.000 ELEVON - 15.000
x	4.960		

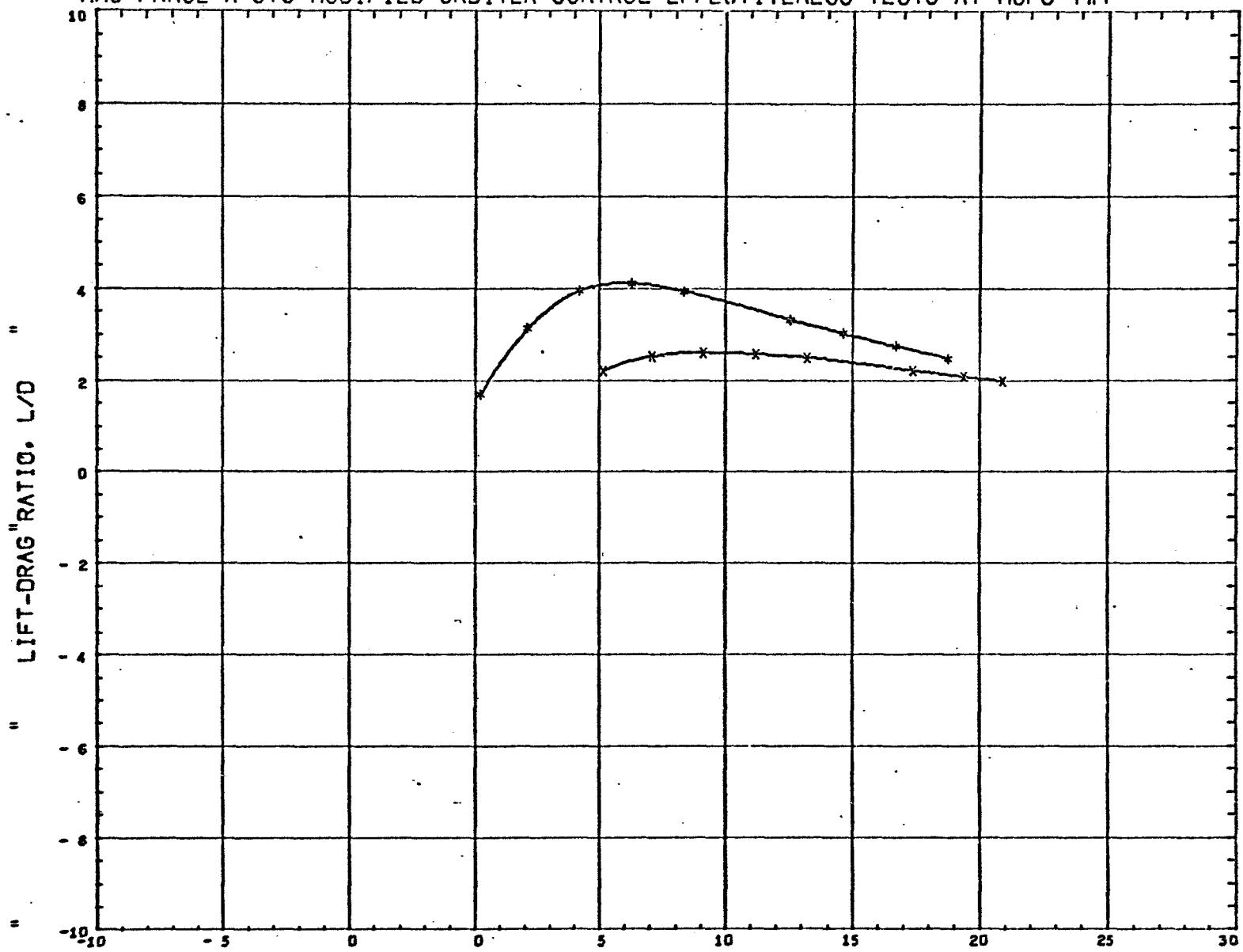
REFERENCE INFORMATION		
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REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(R17023) 02 JUL 70 PAGE 17

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK, ALPHA DEGREES**

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.395		0.000 ELEVON - 15.000
x	4.960		

REFERENCE INFORMATION		
REFS	0.118	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

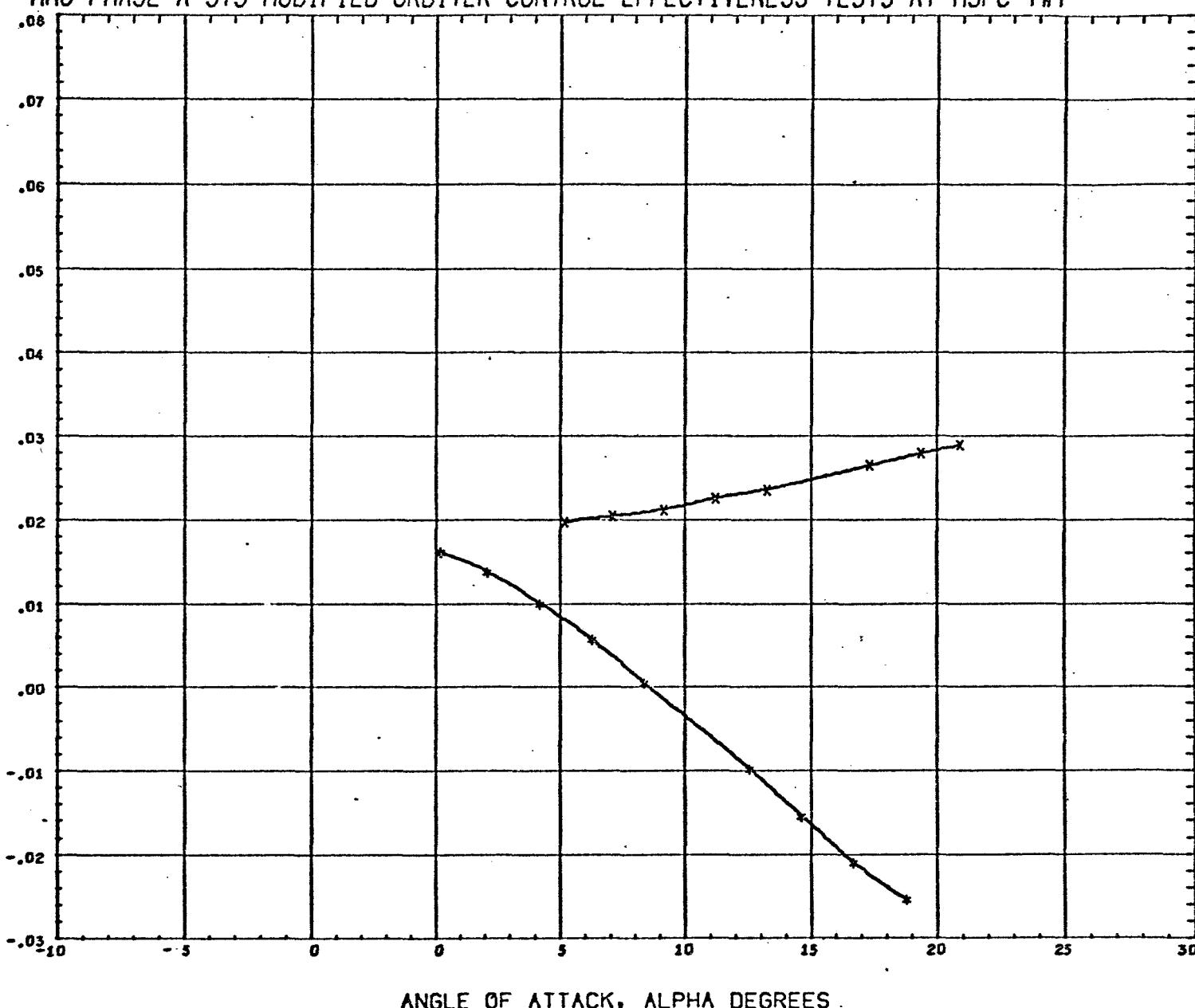
**REFERENCE FILE**

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(R17023) 02 JUL 70 PAGE 18

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY" AXIAL FORCE COEFFICIENT, CAFOR



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH BETA PARAMETRIC VALUES  
 \* 0.395 0.000 ELEVON - 15.000  
 X 4.960

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.455	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

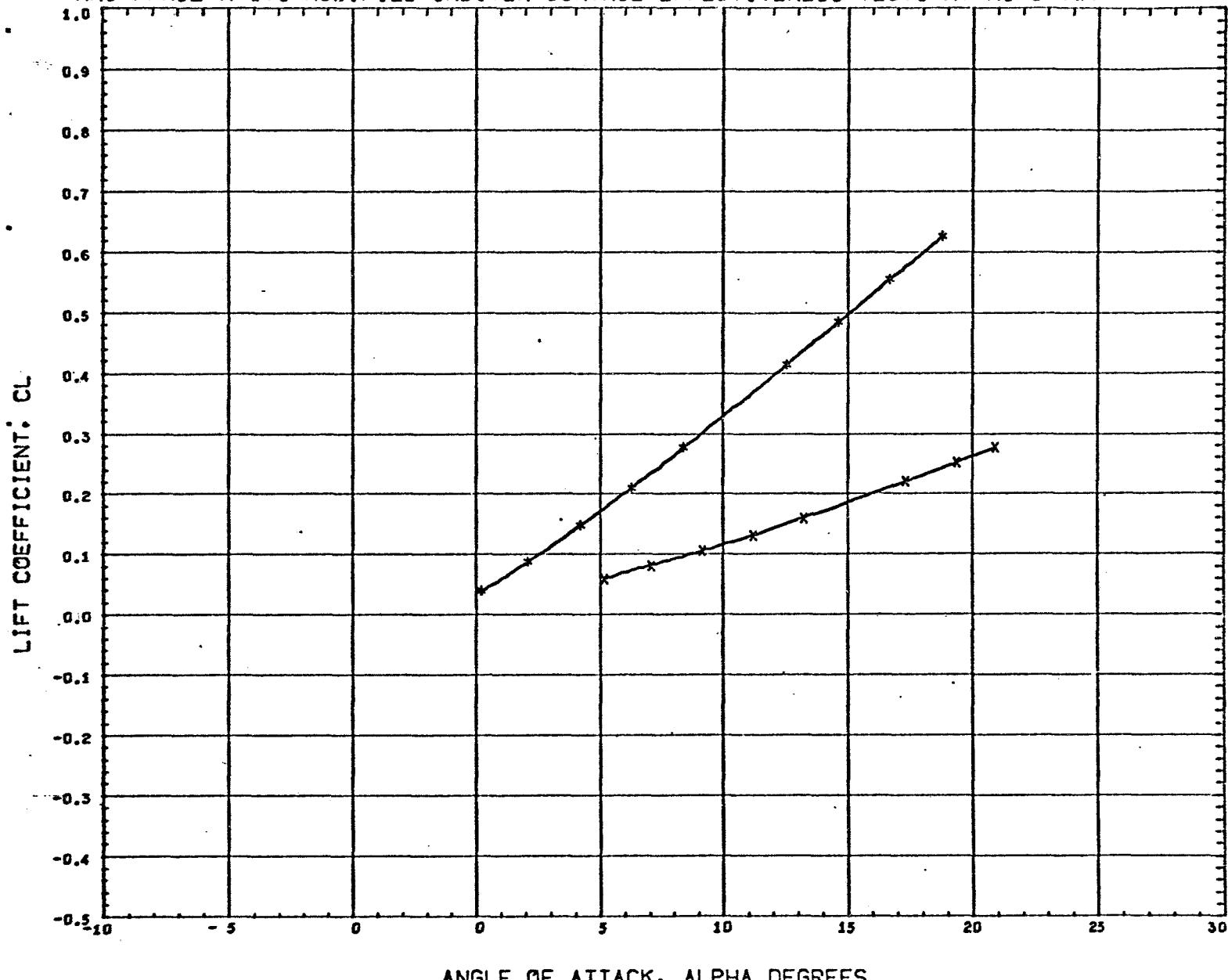
MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(R17023) 02 JUL 70

PAGE

19

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**PARAMETRIC VALUES**

<b>SYMBOL</b>	<b>MACH</b>	<b>BETA</b>	<b>0.000</b>	<b>ELEVON</b>	<b>- 15.000</b>
*	0.395				
x	4.960				

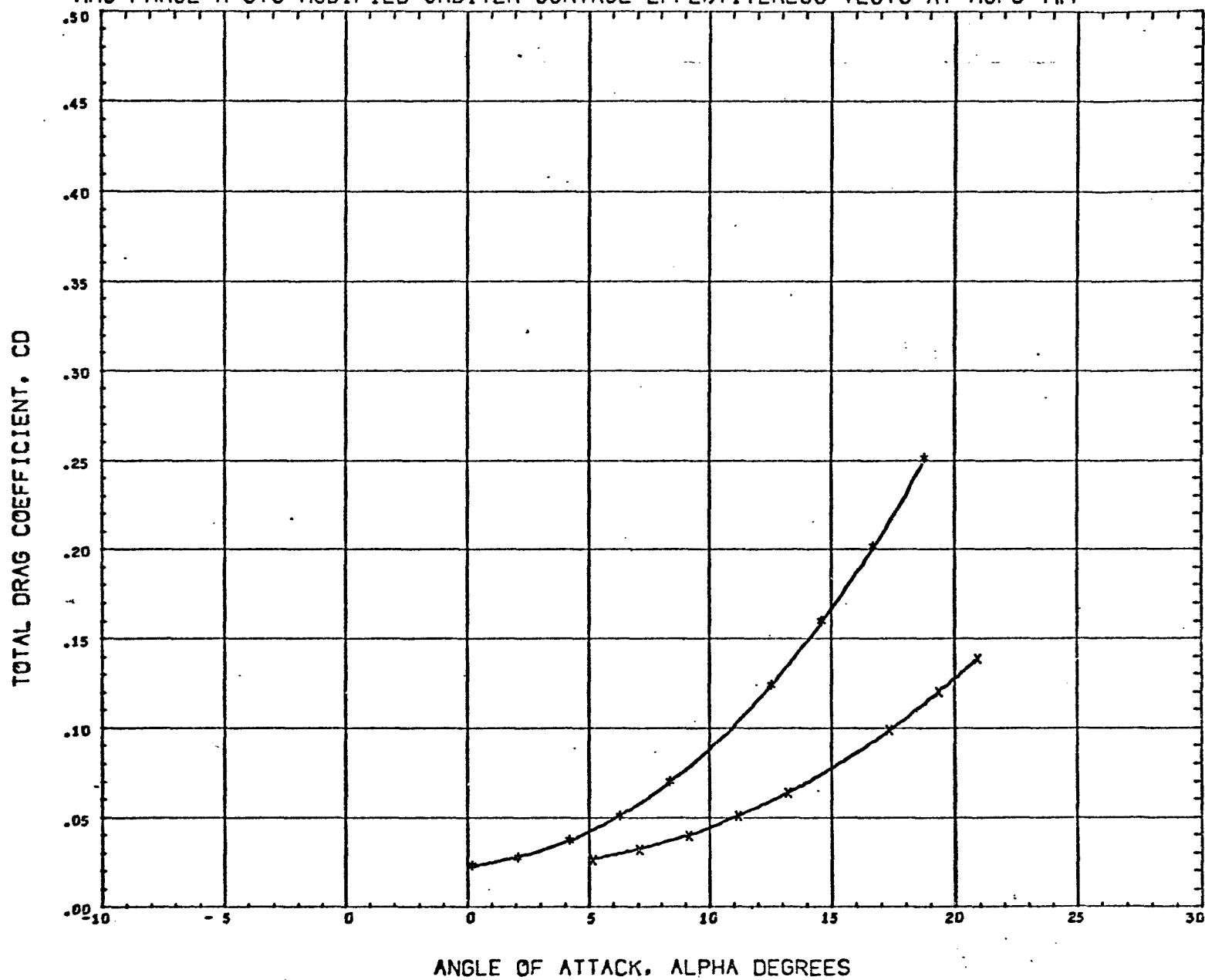
REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRP	0.406	
YMRP	0.500	
ZMRP	0.045	

REFERENCE FILE

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(S17023) 02 JUL 70 PAGE 20

## MMC-PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



<b>SYMBOL</b>	<b>MACH</b>	<b>BETA</b>	<b>PARAMETRIC VALUES</b>
*	0.395		0.000 ELEVON - 15.000
x	4.960		

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.069	
ZHRF	0.045	

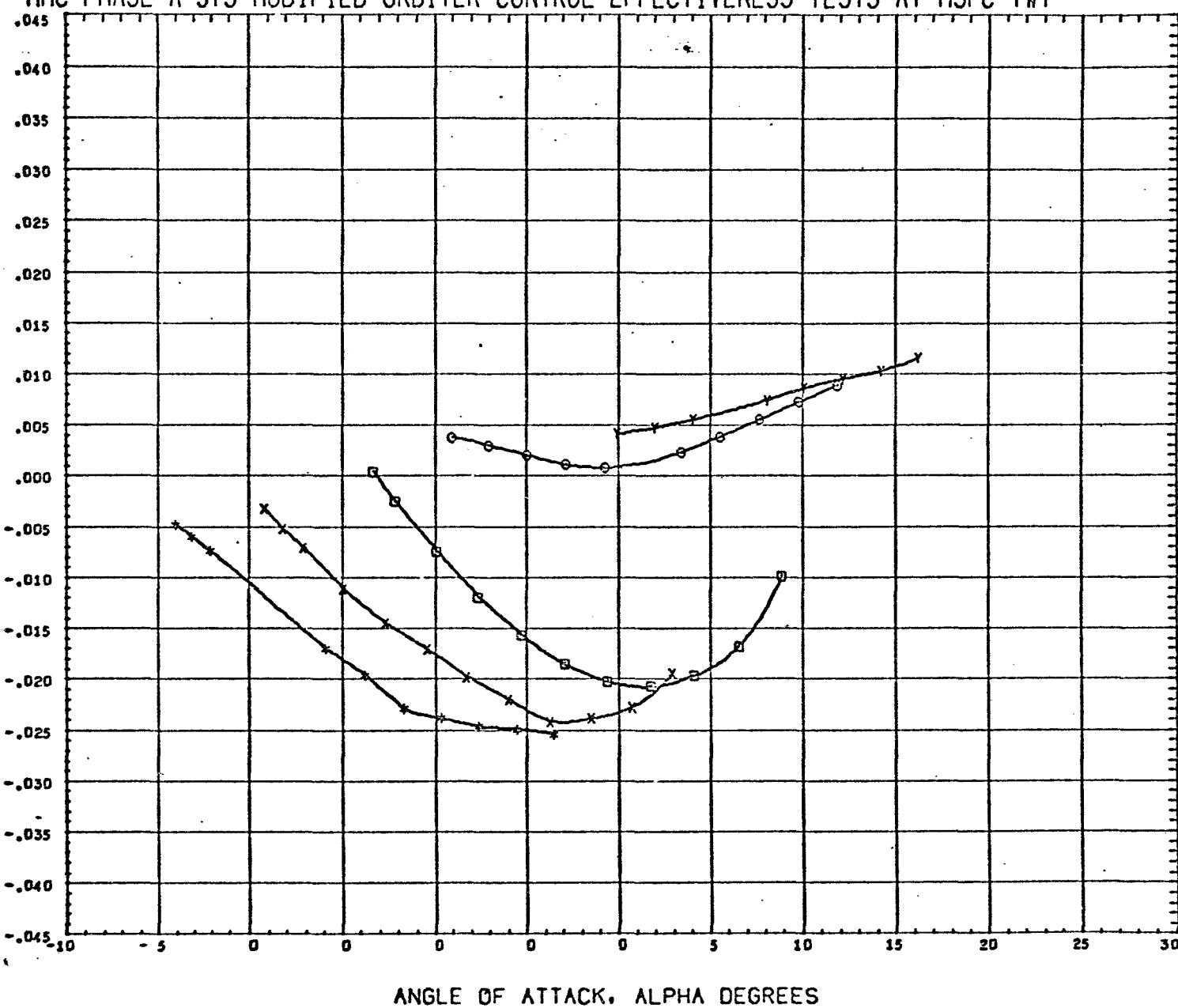
**REFERENCE FILE.**

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(S17023) 02 JUL 70 PAGE 21

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CM



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES	
*	0.398		0.000	RUDGER 0.000
x	0.797			
o	1.199			
e	2.745			
v	4.965			

REFERENCE FILE.

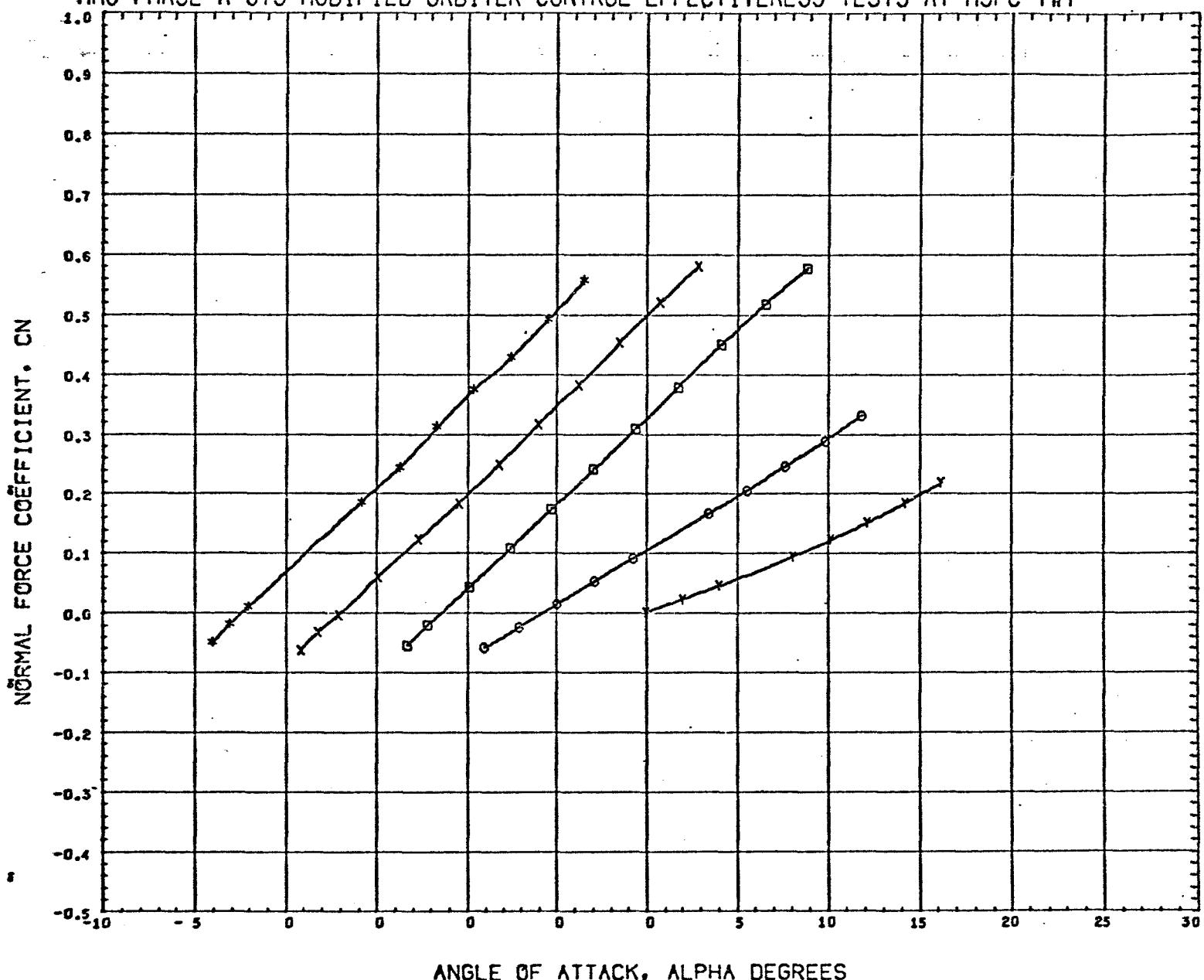
MSFC 453 MMC MOD ORB B2W2T1R1 DEL R0

(R17024) 02 JUL 70

PAGE 22

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRP	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK. ALPHA DEGREES

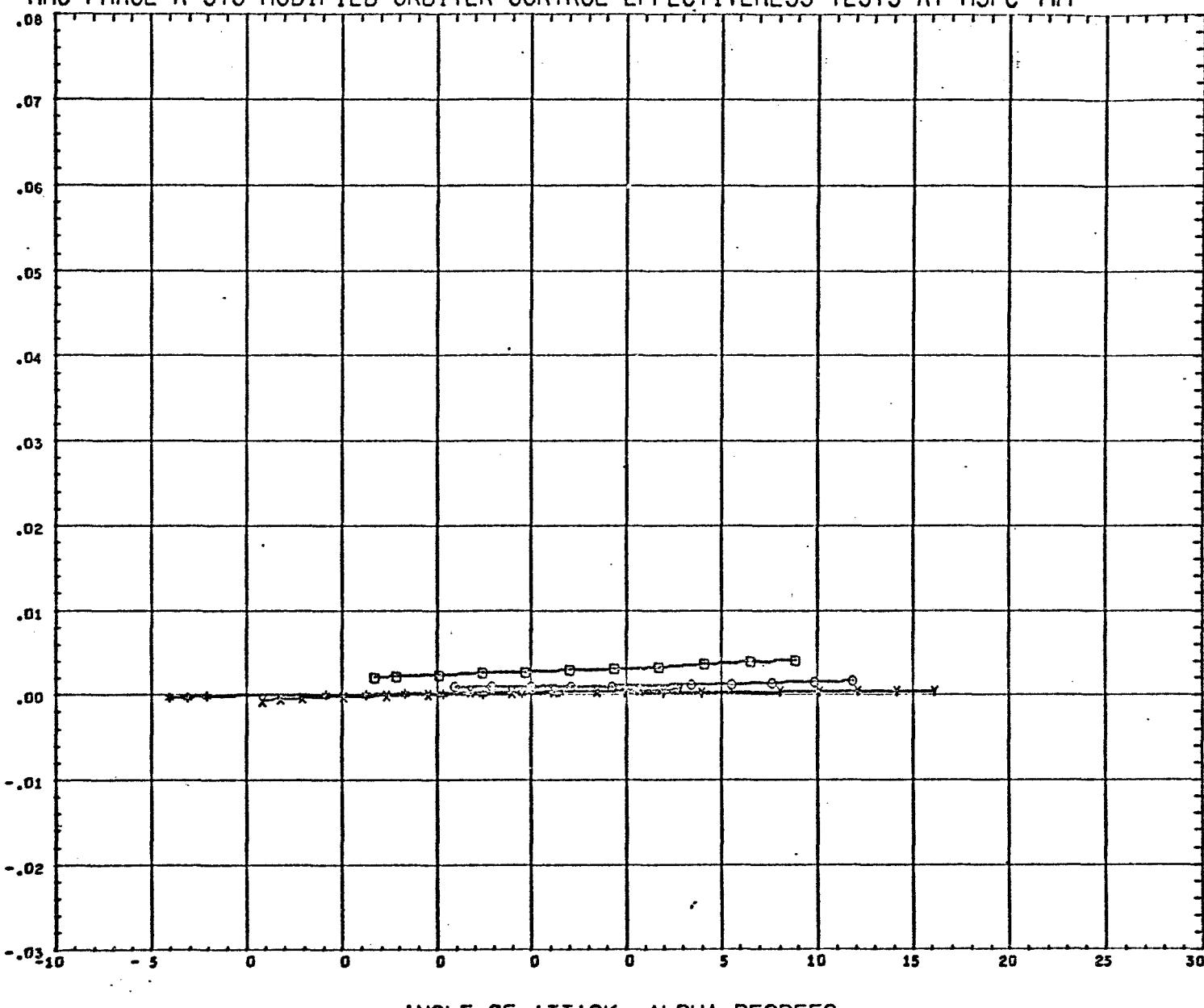
SYMBOL	MACH	BETA	PARAMETRIC VALUES	
			0.000	0.000
*	0.398		0.000	RUDER
x	0.797			
G	1.199			
E	2.745			
T	4.960			

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, C<sub>A,BASE</sub>



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES	
			0.000	0.000
*	0.398			
X	0.797			
G	1.199			
G	2.740			
Y	4.960			

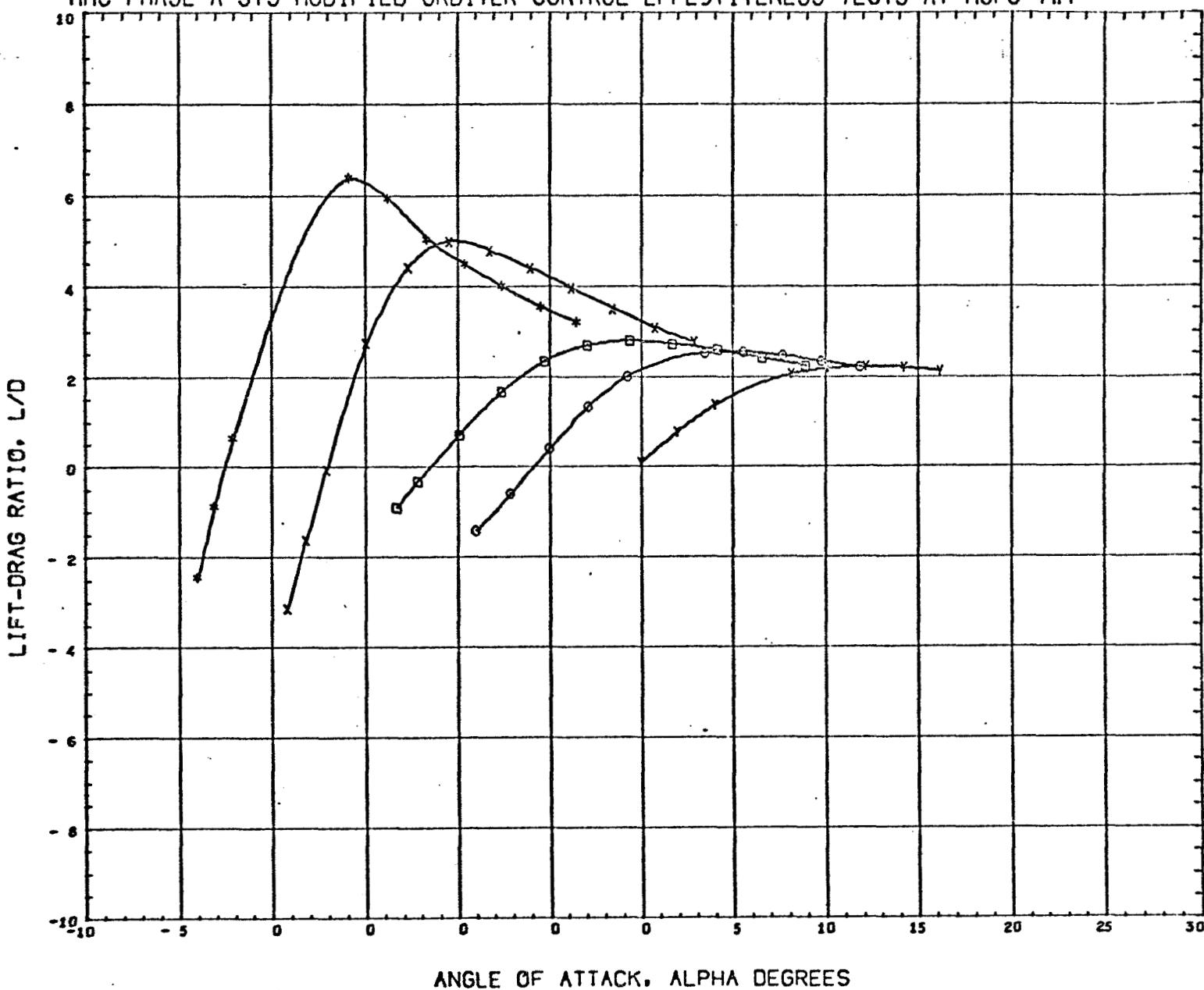
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MSFC 453 MMC MOD ORB B2W2T1R1 DEL R0

(R17024) 02 JUL 70 PAGE 24

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REFL	0.645	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH		PARAMETRIC VALUES	
•	0.398	BETA	0.000	RUDDER
X	0.797			
G	1.199			
•	2.749			
F	4.969			

## REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1R1 DEL R0

(R17024) 02 JUL 70

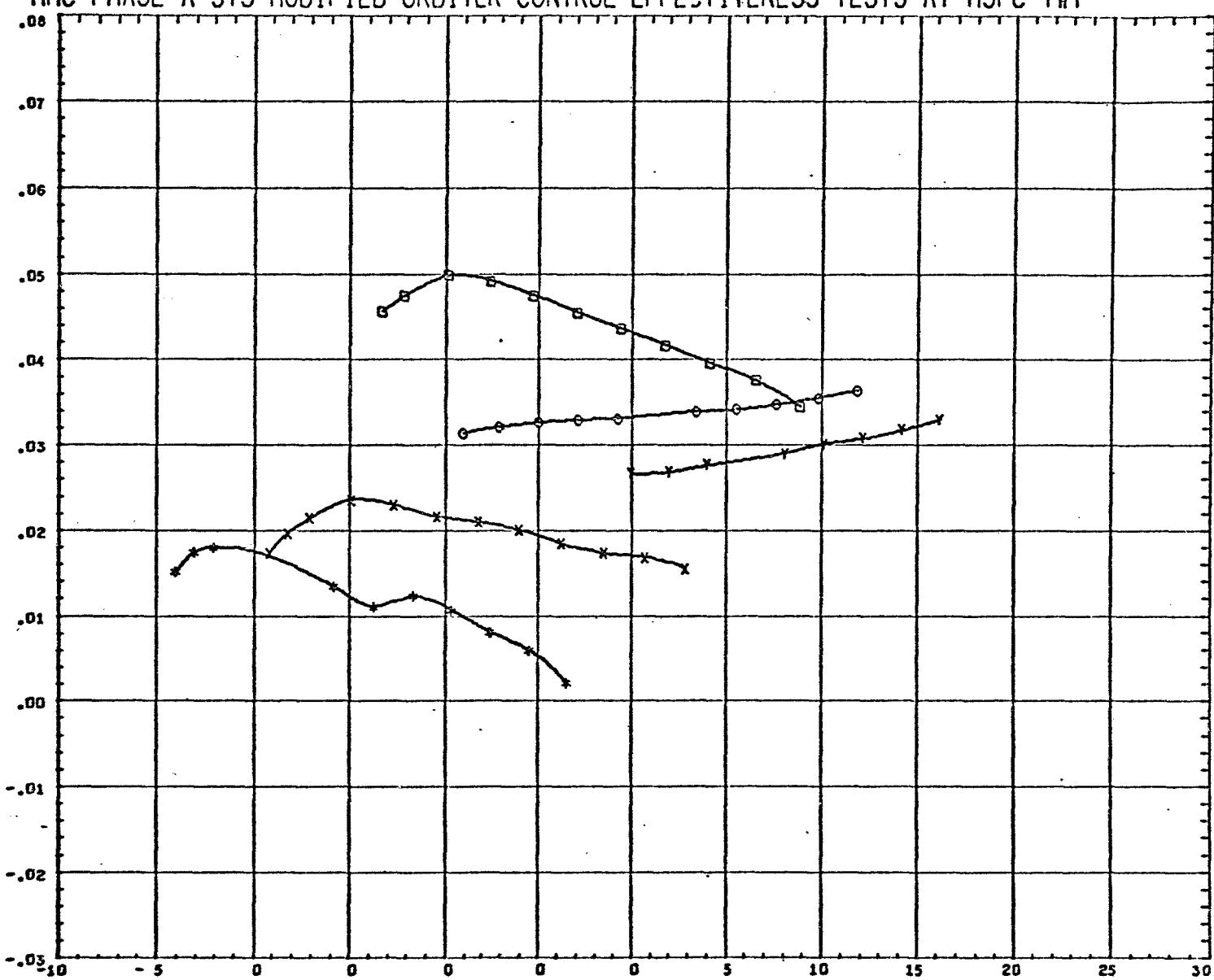
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REFERENCE INFORMATION		
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REFB	0.405	FT.
XHRF	0.406	
YNRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, C<sub>AFORE</sub>



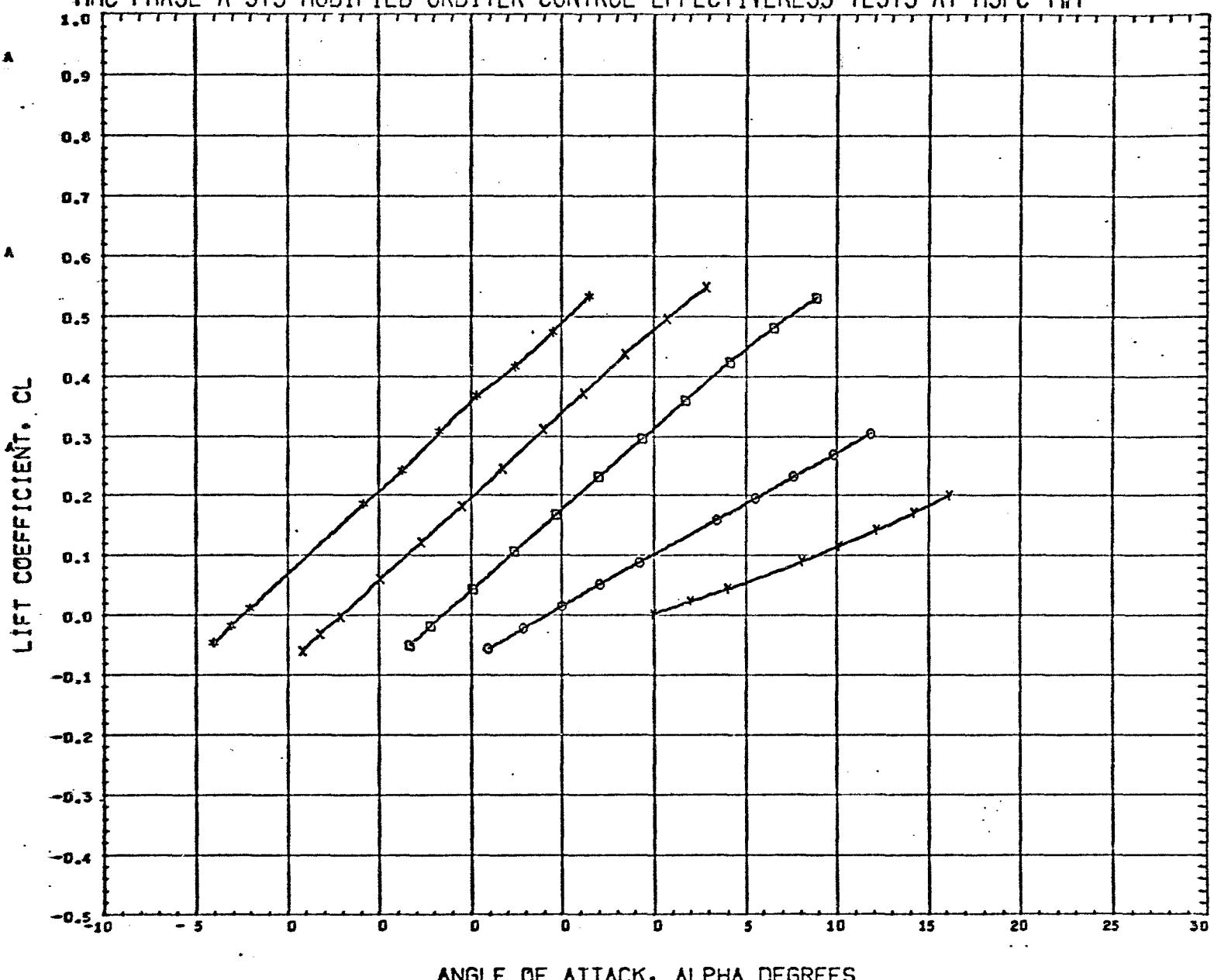
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	PARAMETRIC VALUES		
		BETA	0.000	RUDGER
*	0.398			0.000
x	0.797			
G	1.199			
o	2.745			
T	4.960			

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



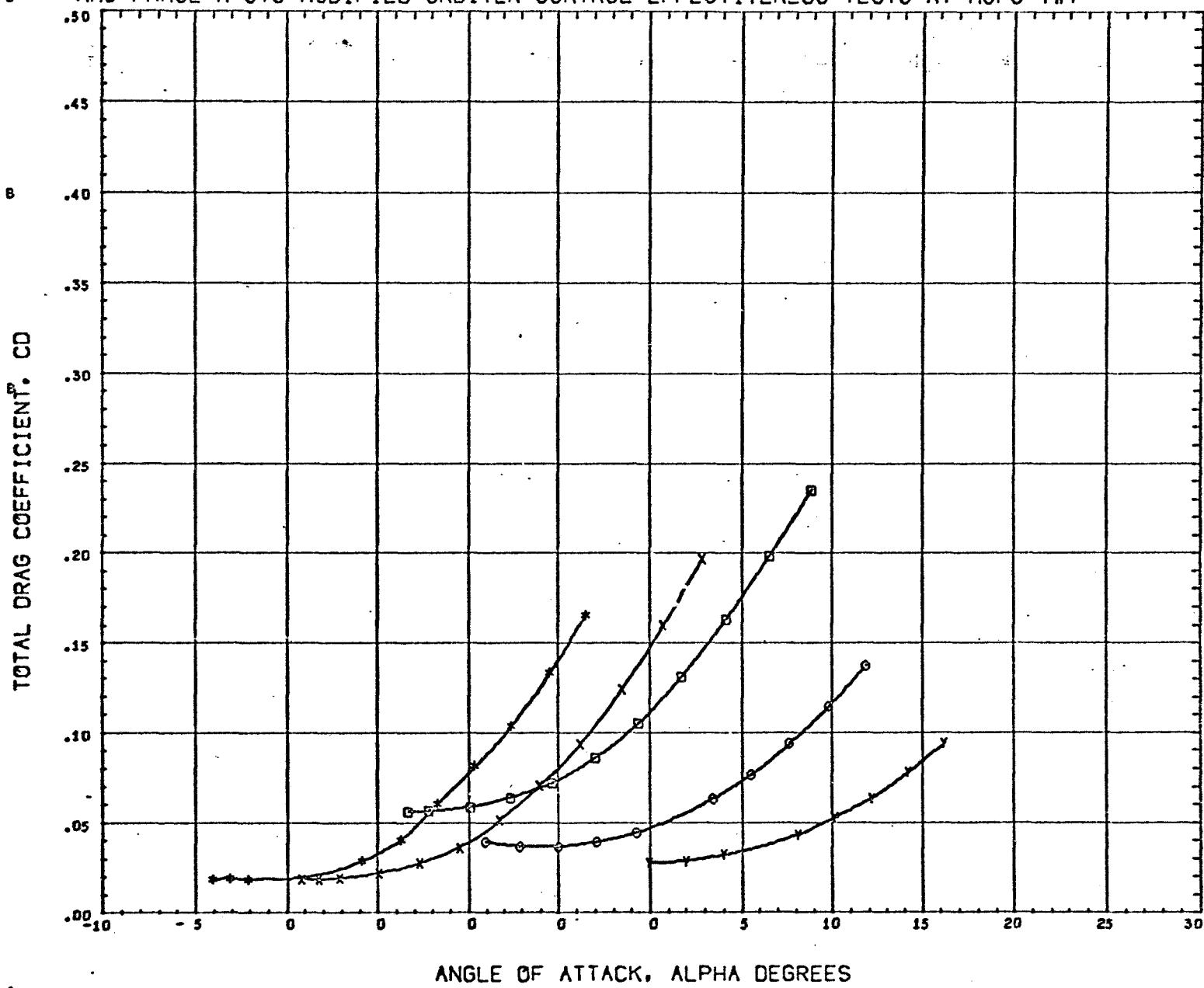
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES	RUDER
•	0.398		0.000	0.000
X	0.797		0.000	0.000
G	1.199		0.000	0.000
M	2.740		0.000	0.000
Y	4.960		0.000	0.000

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.005	
ZMRF	0.045	

B MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	PARAMETRIC VALUES			REFERENCE INFORMATION
		BETA	0.000	RUDER	
*	0.398				REFS 0.116 SQ.FT.
x	0.797				REFL 0.646 FT.
o	1.199				REFB 0.405 FT.
o	2.746				XNRF 0.406
y	4.960				YMRF 0.000

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2TIR1 DEL R0

(S17024) 02 JUL 70

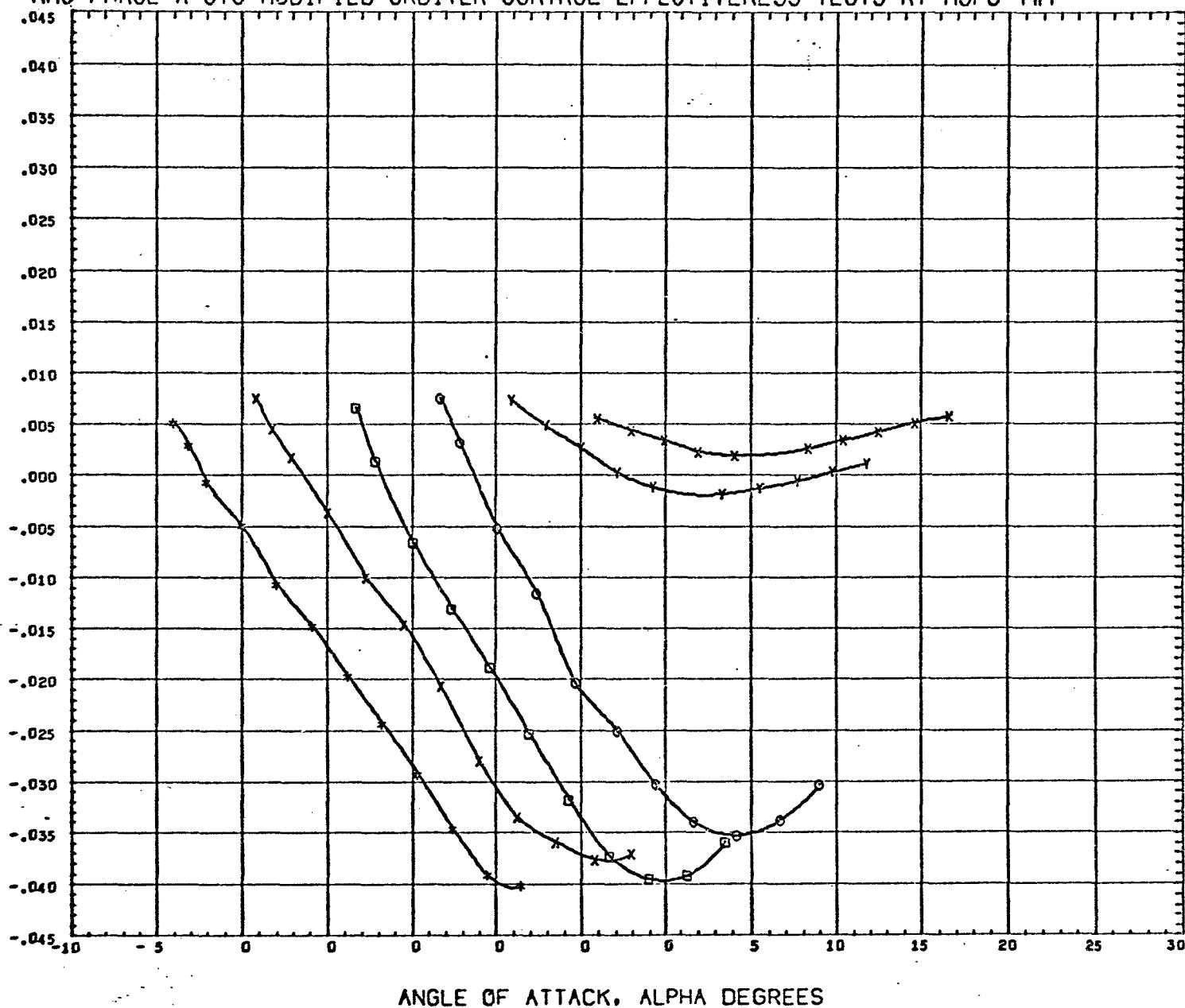
PAGE

28

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

B

PITCHING MOMENT COEFFICIENT, C<sub>NM</sub>



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	PARAMETRIC VALUES	
*	0.396	BETA	0.000 ELEVON 0.000
x	0.798	RUDGER	0.000
G	0.996		
o	1.199		
y	2.745		
x	3.479		REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

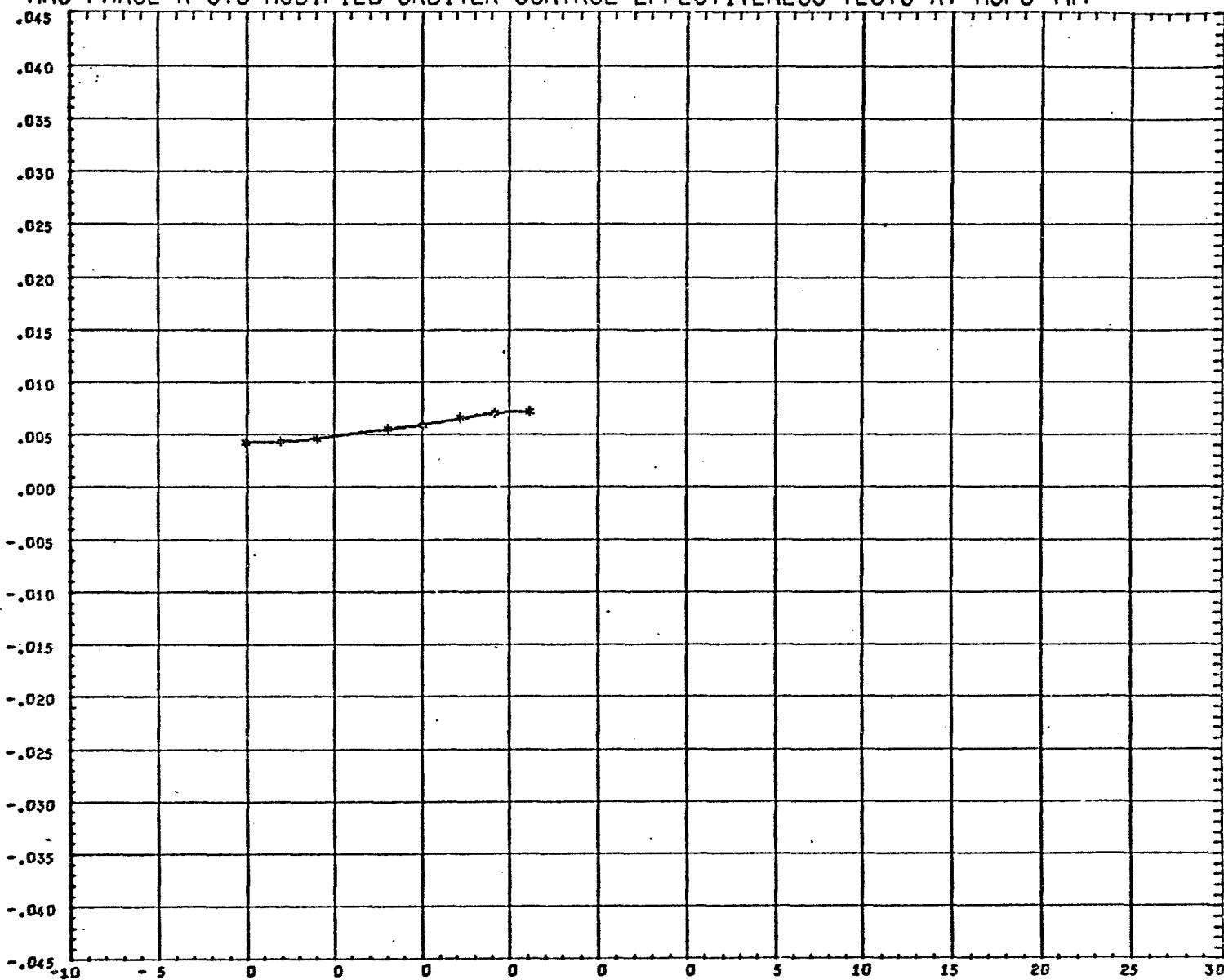
(R17025) 02 JUL 70

PAGE

29

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 4.965 BETA 0.000 ELEVON 0.000  
RUDDER 0.000

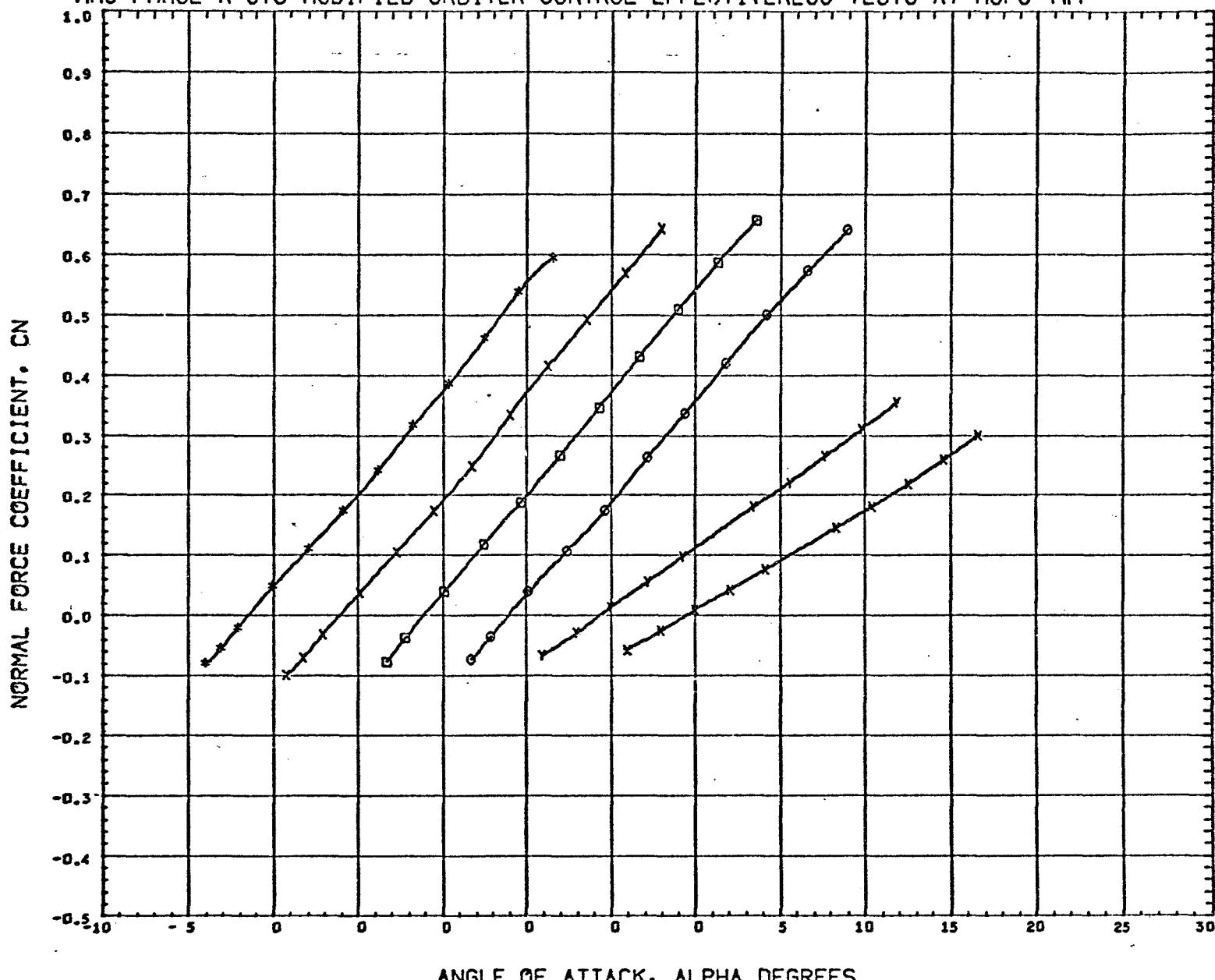
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REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

(R17025) 02 JUL 70 PAGE 30

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

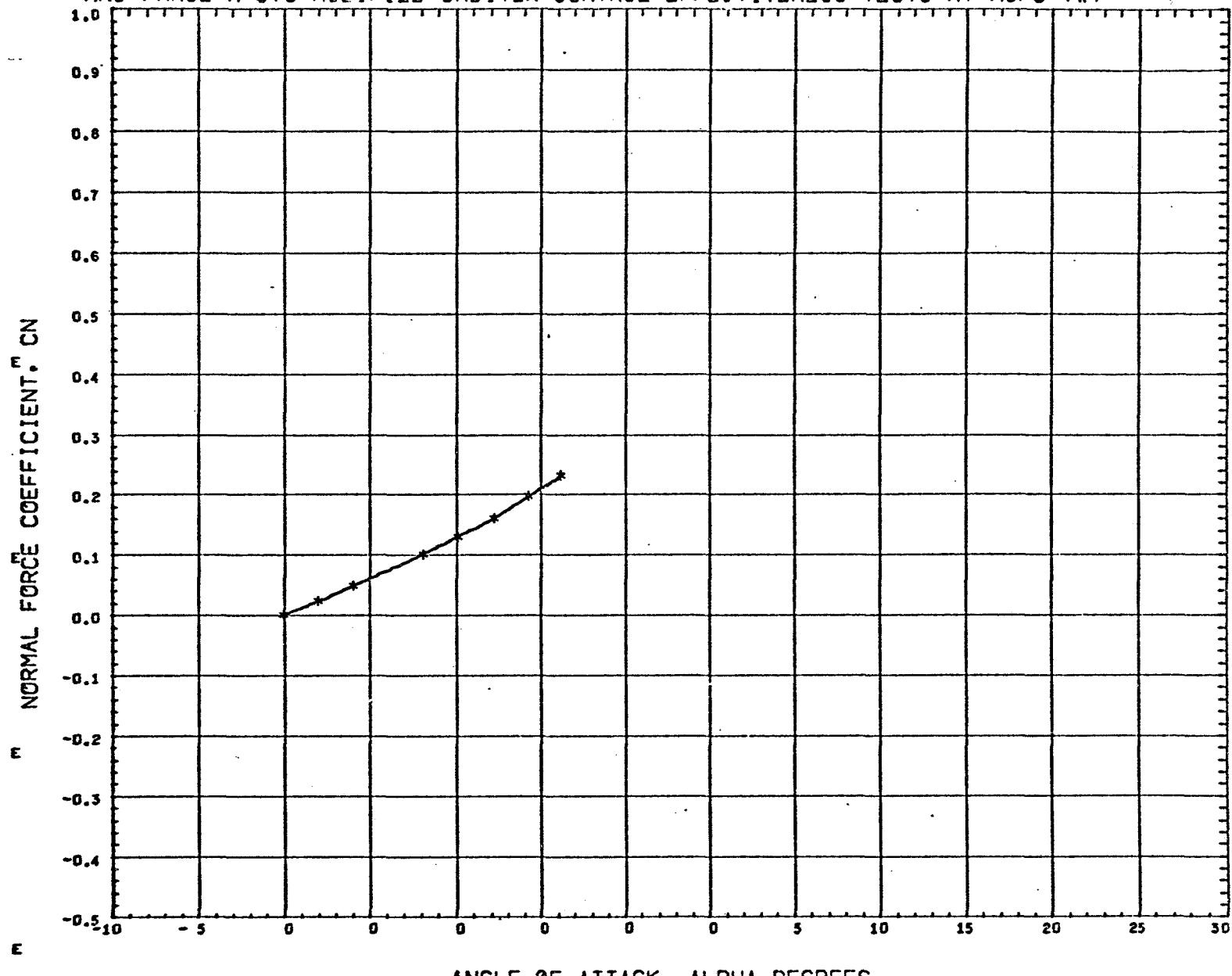


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES	ELEVON	0.000
*	0.396		0.500		
x	0.798	RUDDER	0.500		
G	0.996				
g	1.199				
y	2.740				
x	3.479		REFERENCE FILE.		

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.003	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 \* 4.960 BETA 0.000 ELEVON 0.000  
 RUDDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.406  
 YHRF 0.000  
 ZHRF 0.045

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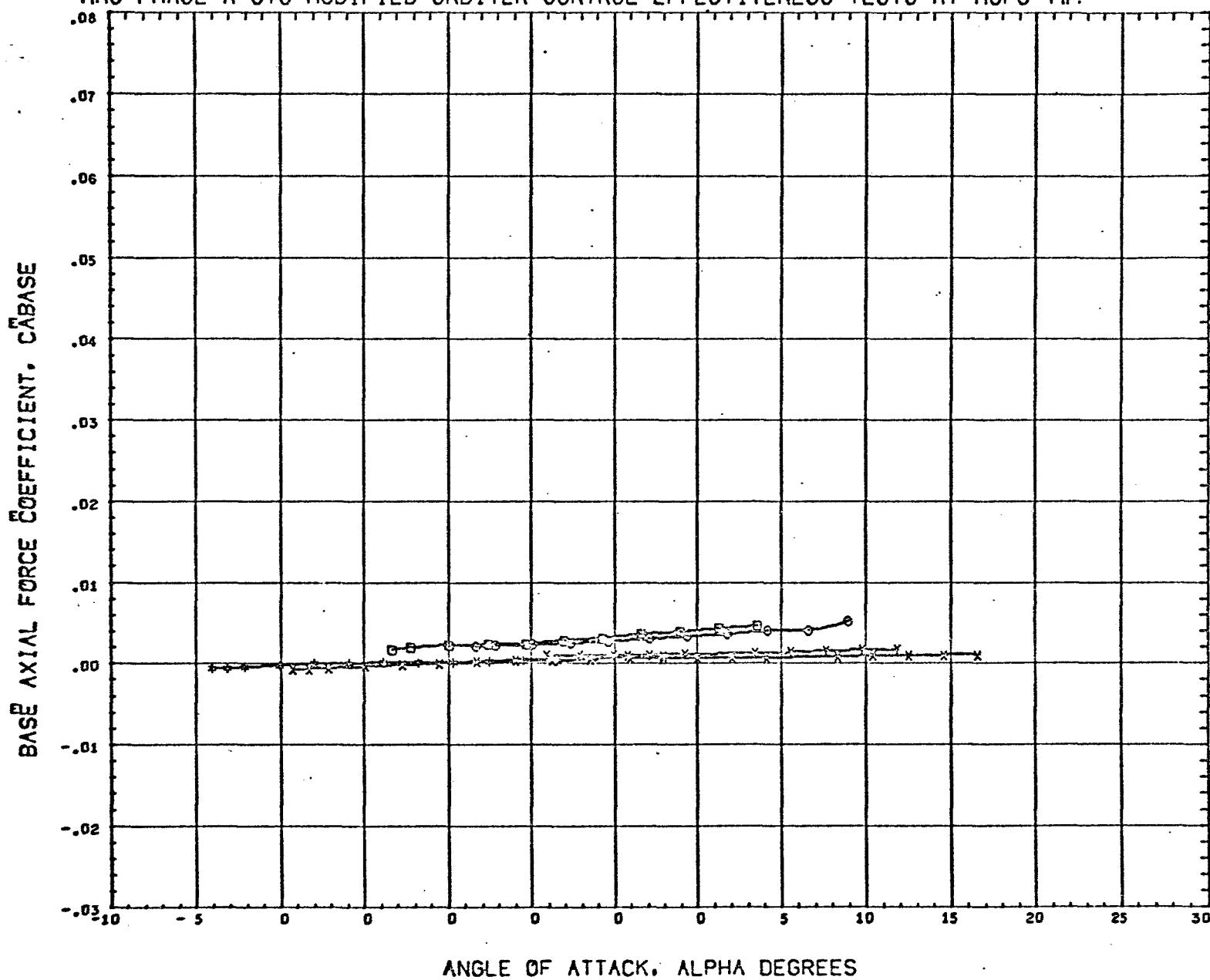
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(R17025) 02 JUL 70

PAGE

32

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



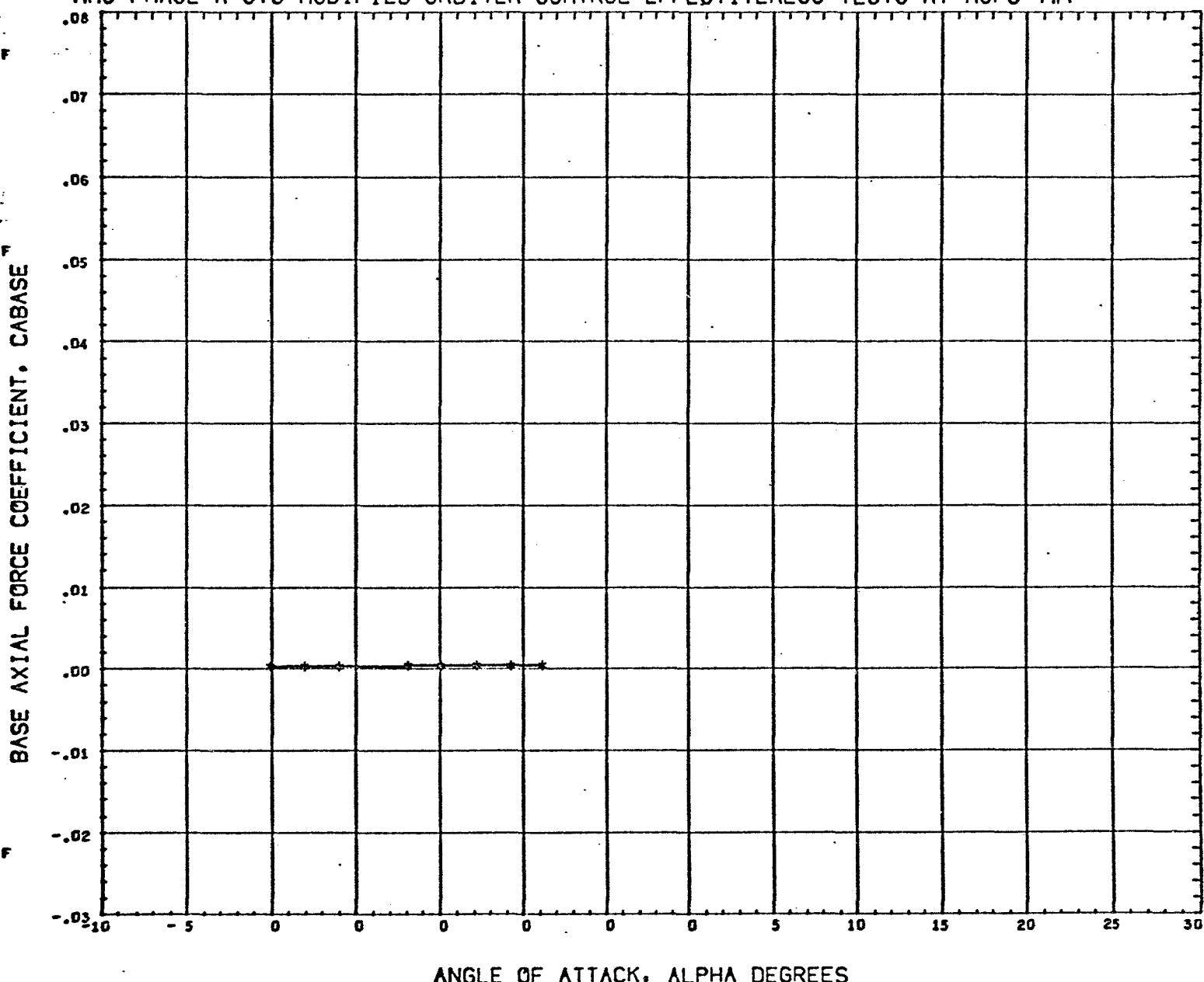
ANGLE OF ATTACK, ALPHA DEGREES

PARAMETRIC VALUES			
SYMBOL	MACH	BETA	ELEVON
*	0.396	0.000	0.000
x	0.798	0.000	0.000
G	0.996		
G	1.199		
T	2.740		
x	3.479		

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



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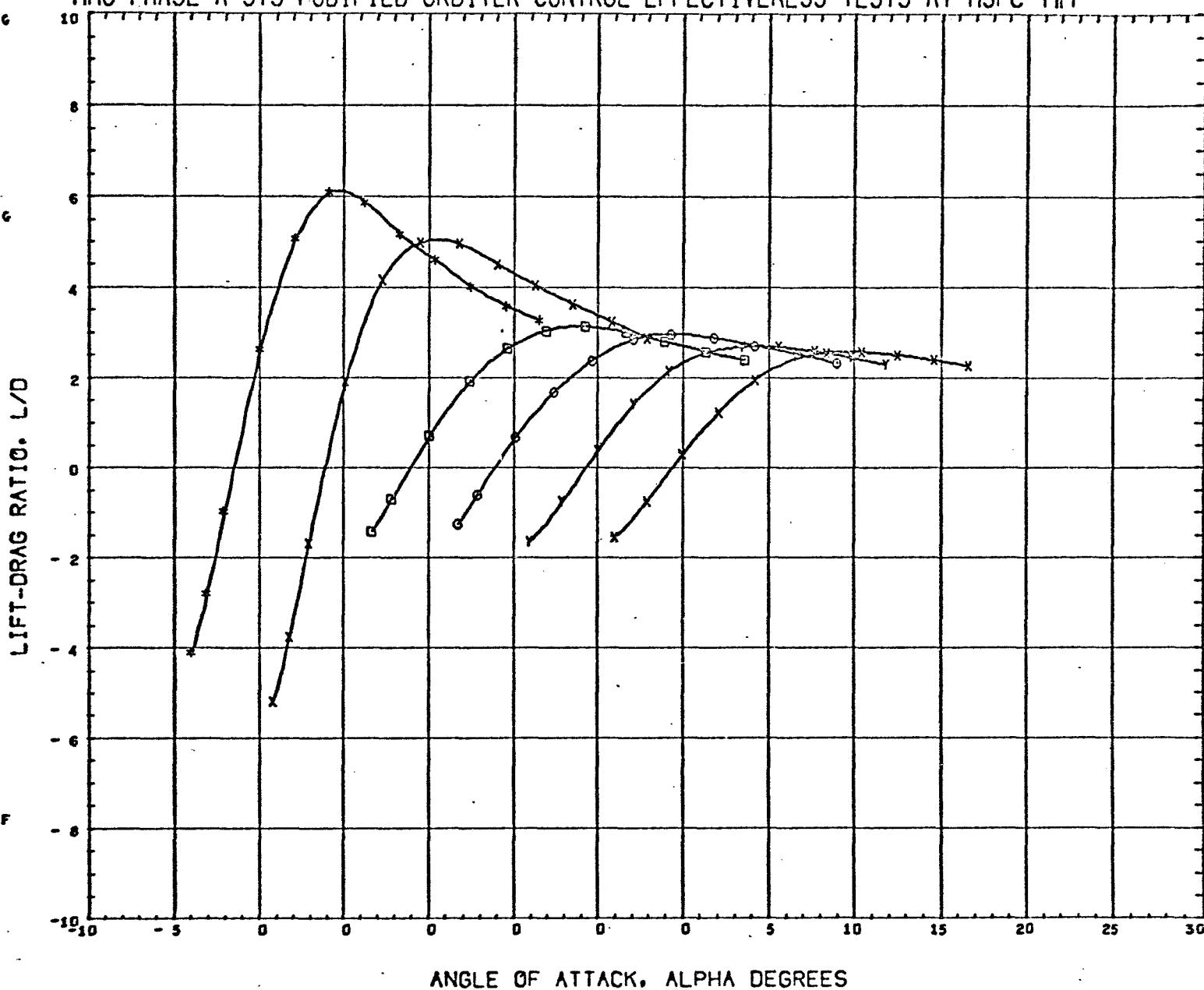
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

(R17025) 02 JUL 70

PAGE

34

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK. ALPHA DEGREES**

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.396		0.000 ELEVON 0.000
x	0.798	RUDER	0.000
G	0.996		
O	1.199		
T	2.740		
X	3.479	REFERENCE FILE.	

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
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REFB	0.405	FT.
XHRF	0.406	
YMRF	0.000	
ZHRF	0.045	

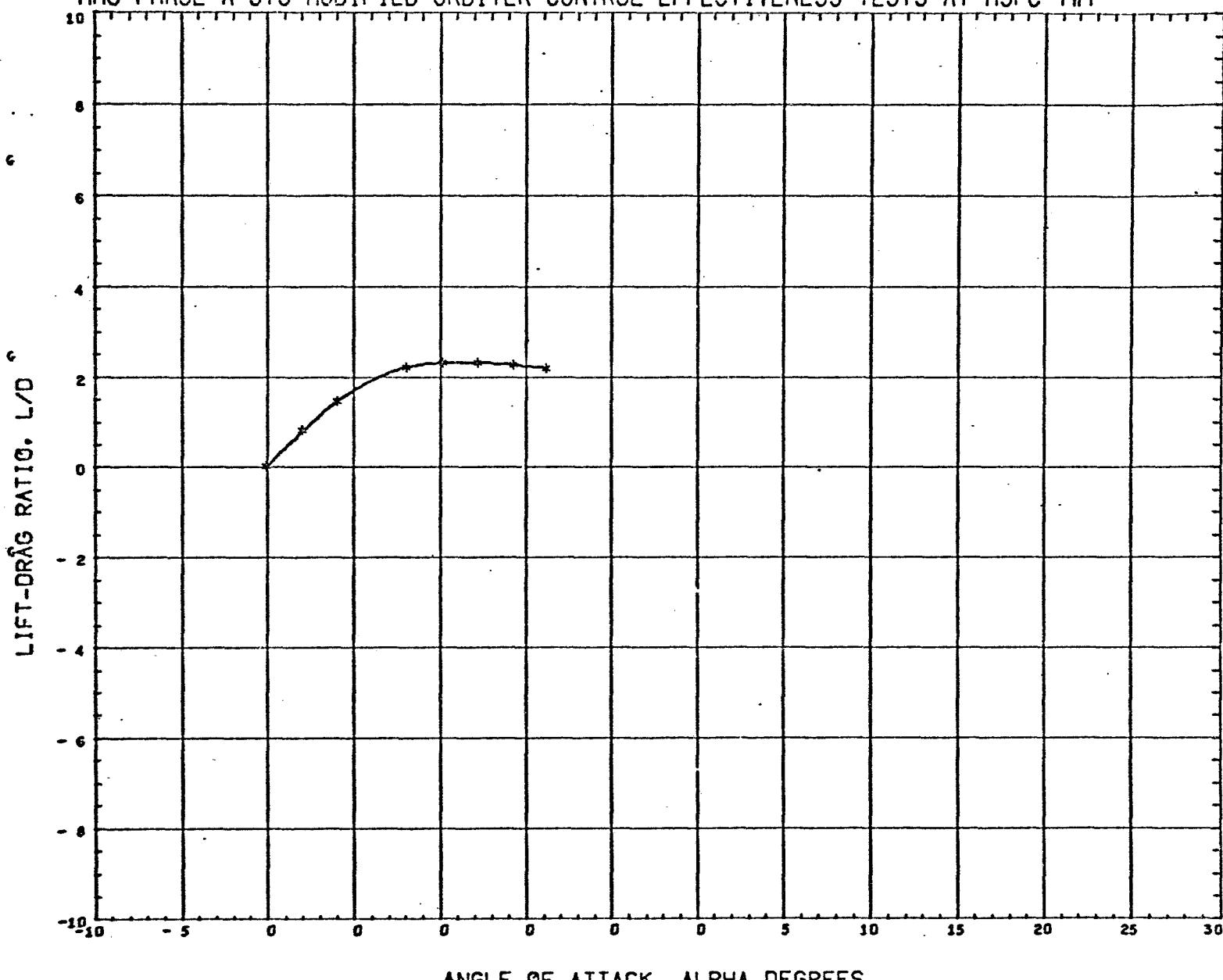
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(R17025) 02 JUL 70

PAGE

35

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 4.965 BETA 0.000 ELEVON 0.000  
RUDDER 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
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REFB	0.405	FT.
XMRP	0.406	
YMRP	0.000	
ZMRP	0.045	

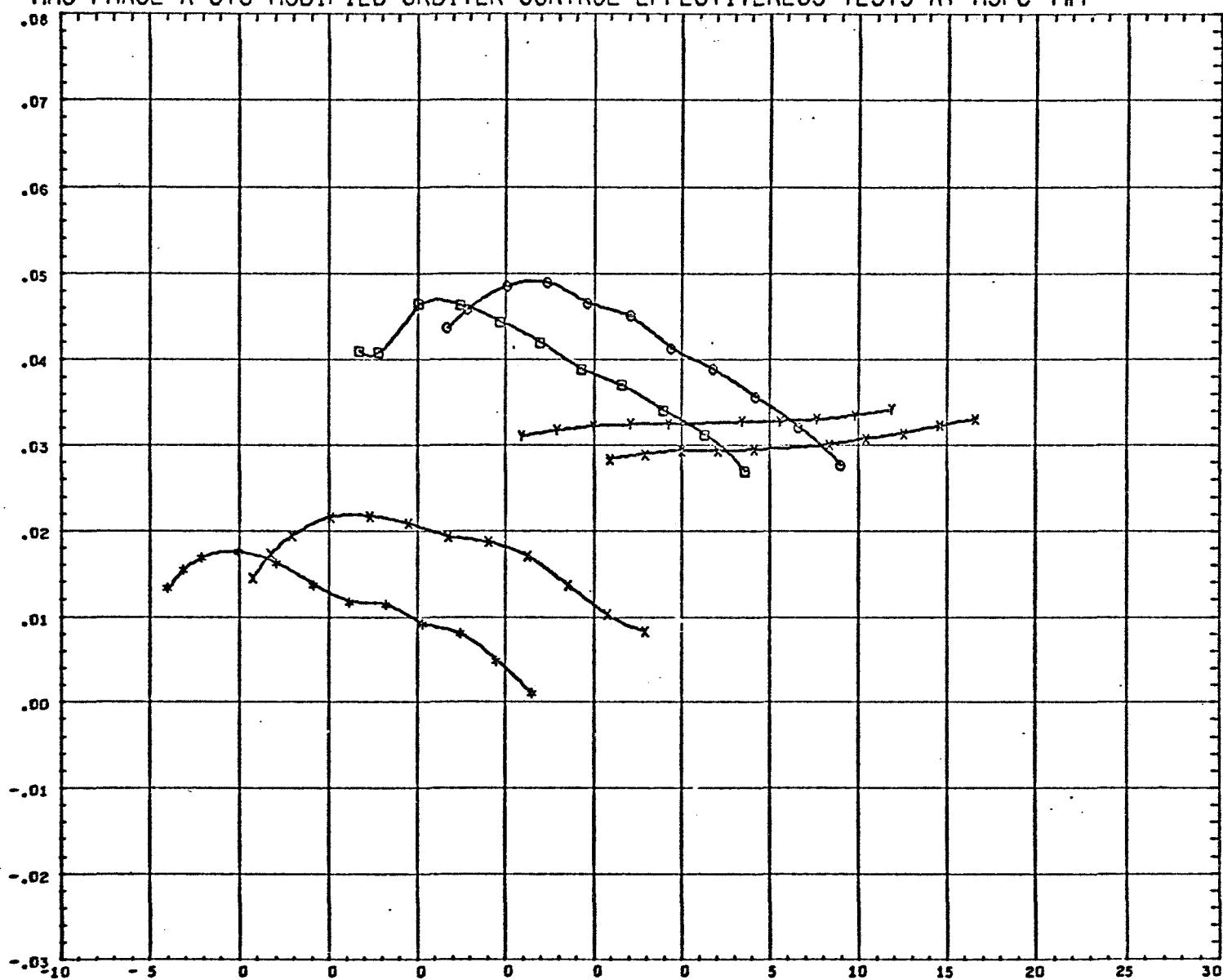
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MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

(R17025) 02 JUL 70 PAGE 36

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

H  
FOREBODY AXIAL FORCE COEFFICIENT. CAFOR



ANGLE OF ATTACK. ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES	ELEVON
*	0.396	0.000	0.000	0.000
x	0.798	RUDER	0.000	0.000
G	0.996			
g	1.199			
v	2.740			
H	3.479		REFERENCE FILE.	

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.406
YHRF 0.000
ZHRF 0.045

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

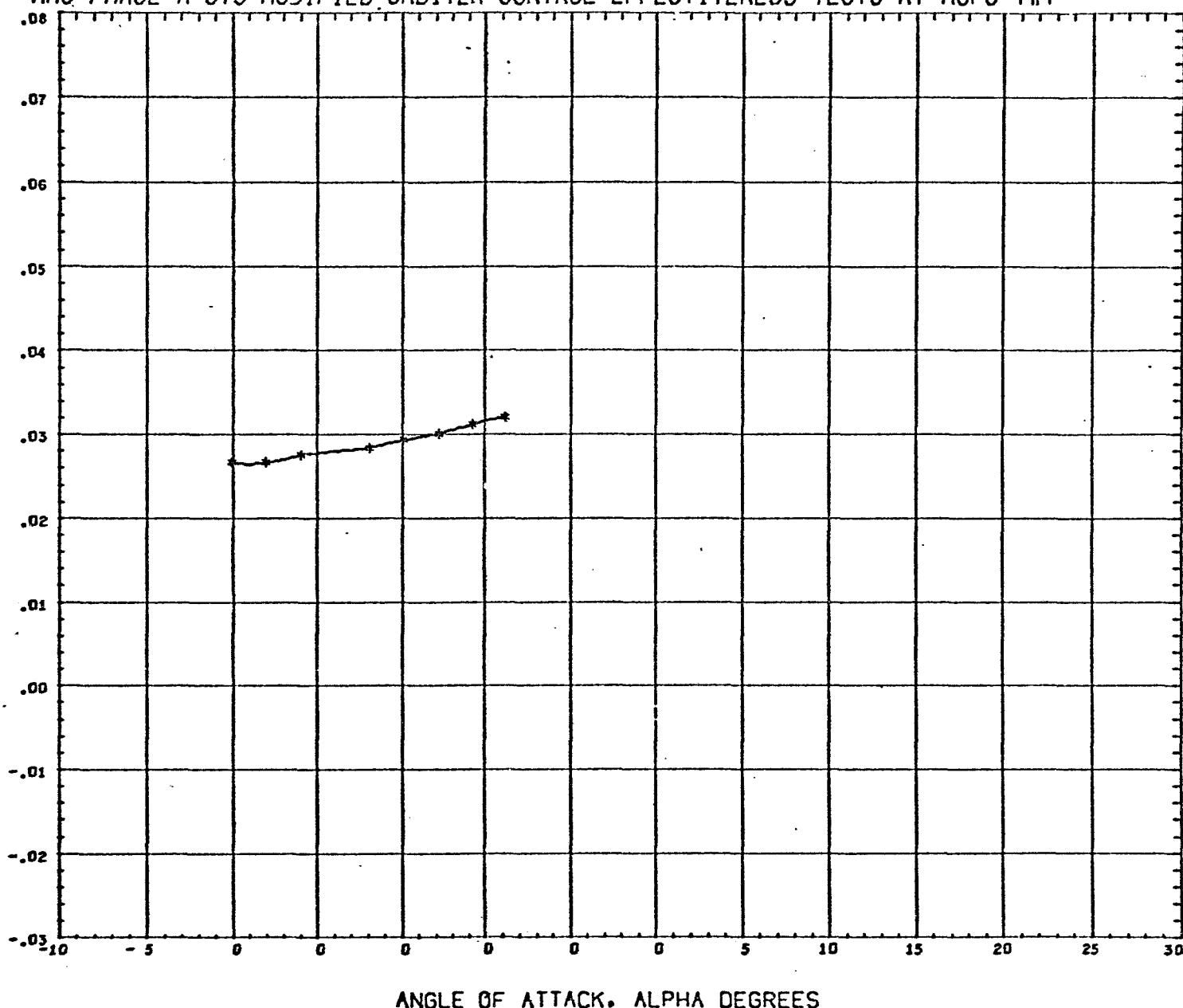
(R17025) 02 JUL 70

PAGE

37

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAF<sub>ORE</sub>



SYMBOL MACH PARAMETRIC VALUES  
 \* 4.960 BETA 0.000 ELEVON 0.000  
 I RUDGER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.406  
 YHRF 0.000  
 ZHRF 0.045

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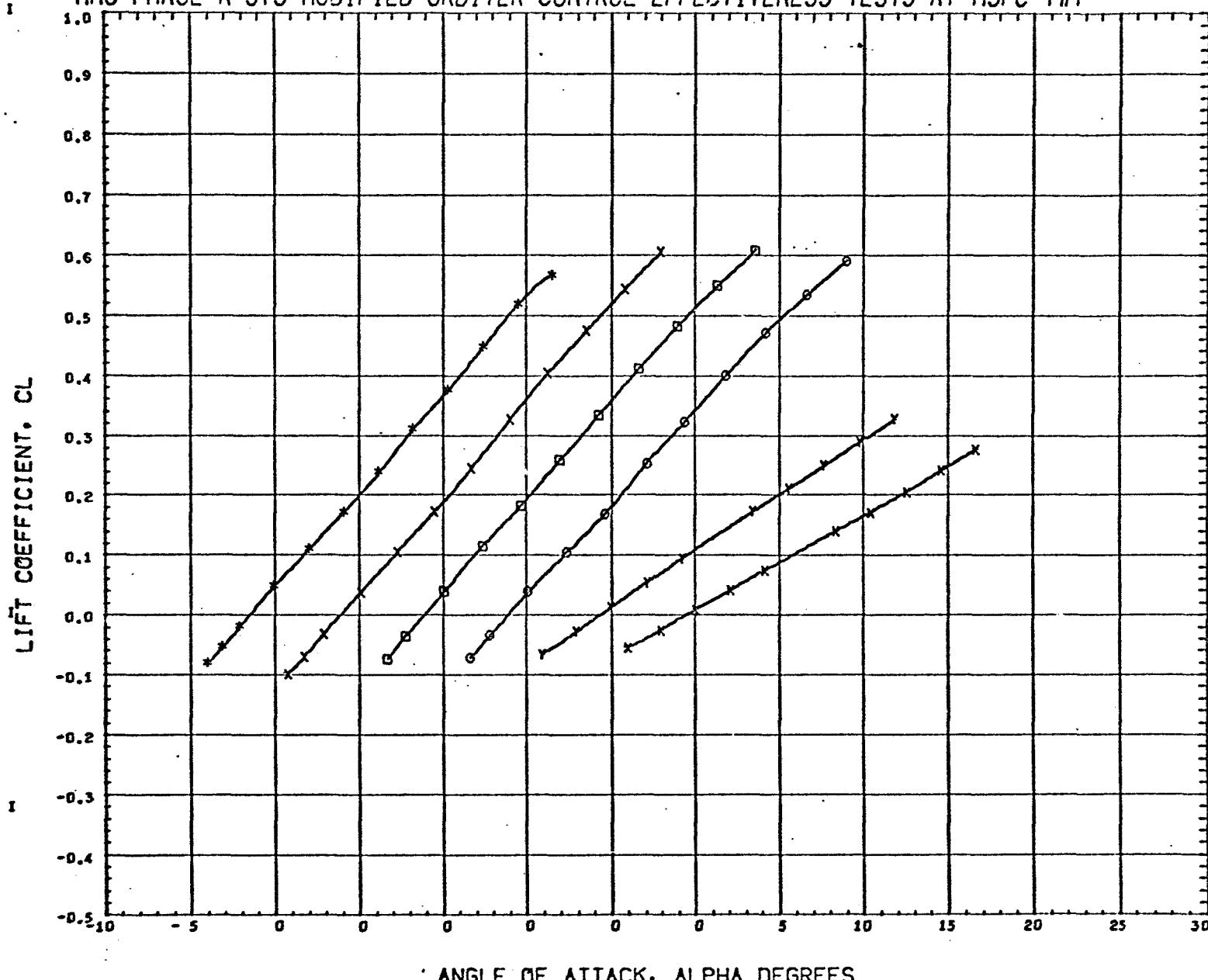
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(R17025) 02 JUL 70

PAGE

38

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK, ALPHA DEGREES**

SYMBOL	MACH		PARAMETRIC VALUES	
*	0.396	BETA	0.000	ELEVON 0.000
x	0.798	RUDDER	0.000	
G	0.996			
G	1.199			
y	2.740			
x	3.479	REFERENCE FILE.		

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
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REFB	0.405	FT.
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YHRF	0.000	
ZHRF	0.045	

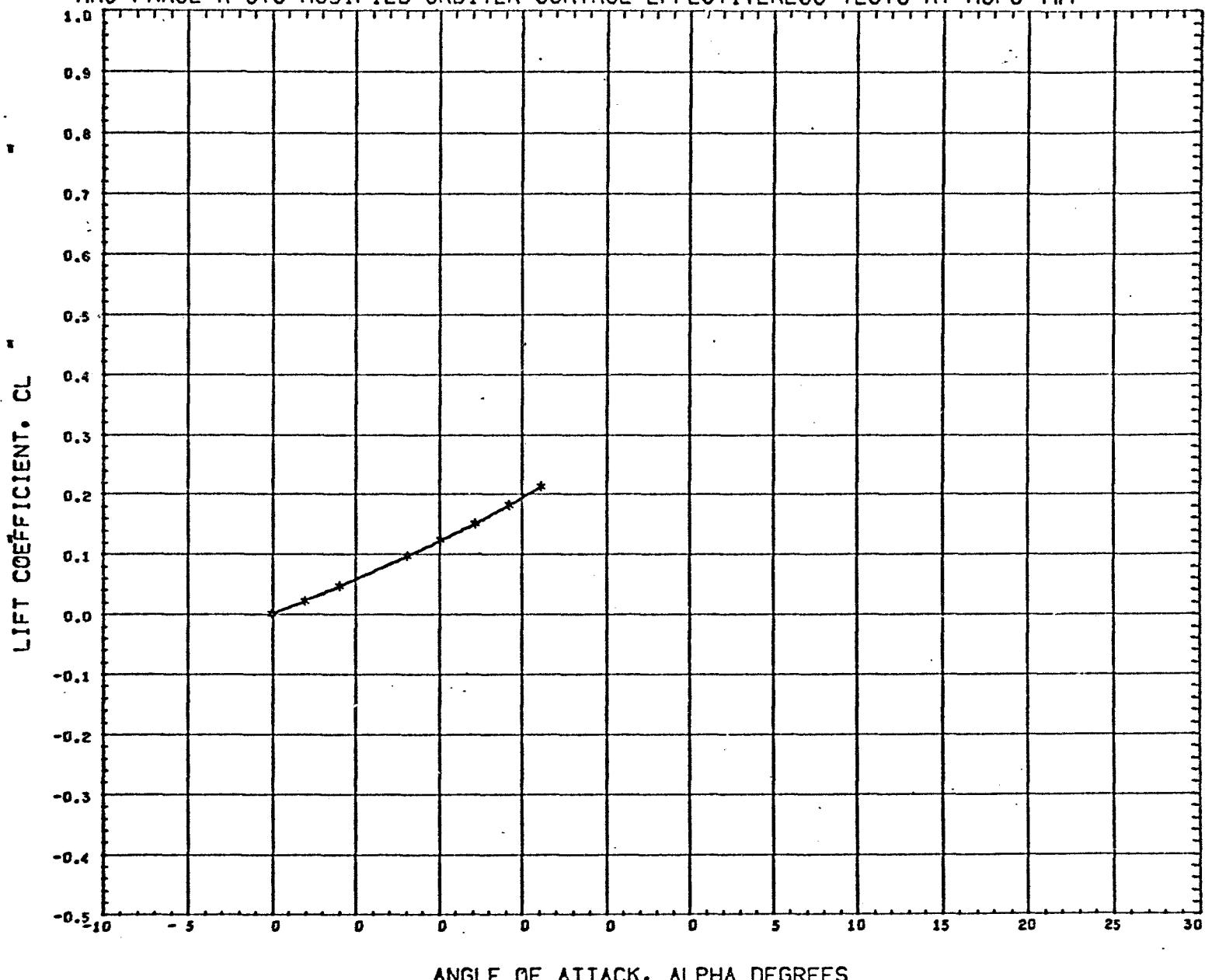
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(S17025) 02 JUL 70

PAGE

39

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 4.960 BETA 0.000 ELEVON 0.000  
RUDDER 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
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REFB	0.405	FT.
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YHRF	0.000	
ZHRF	0.045	

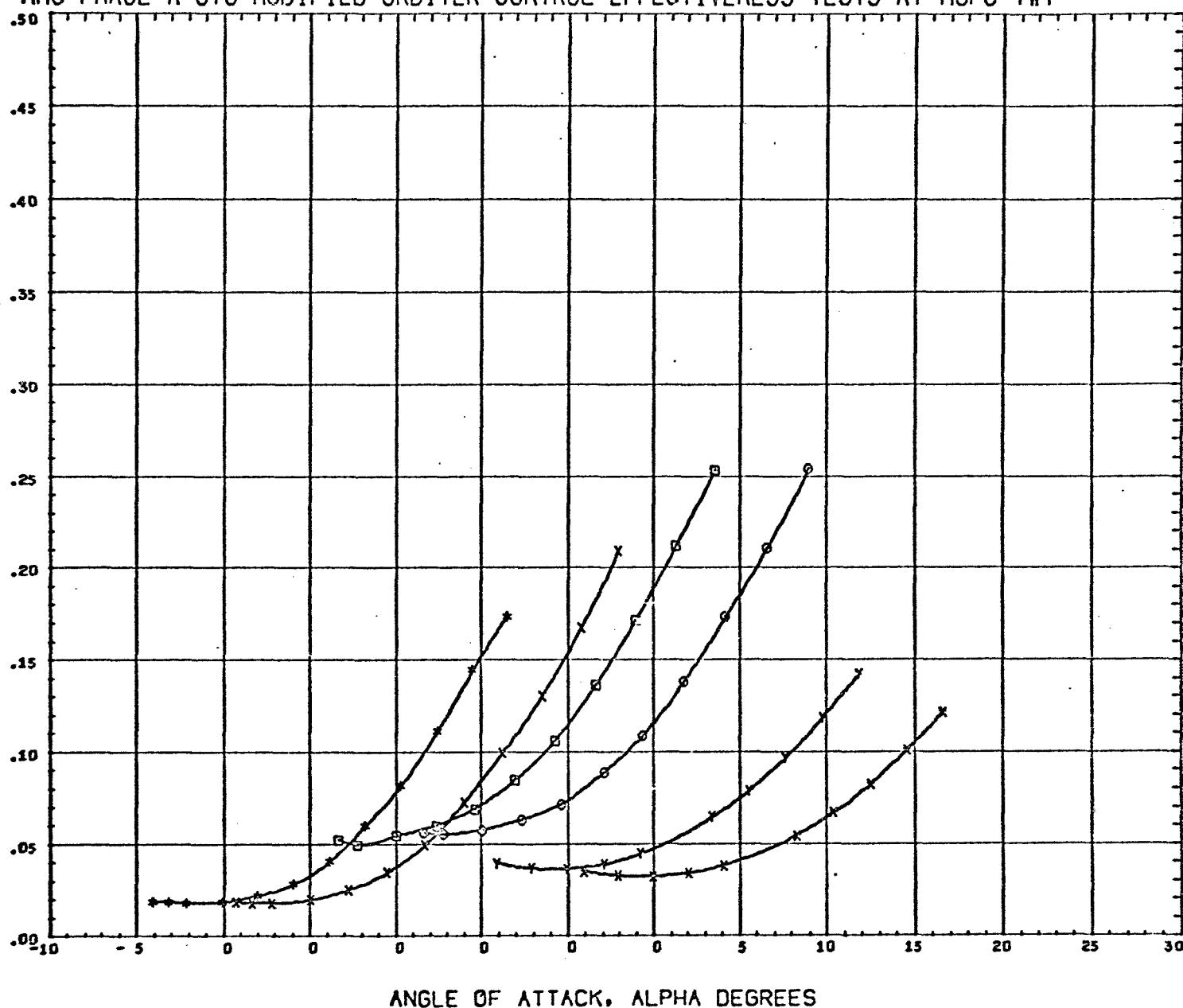
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MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

(S17025) 02 JUL 70 PAGE 40

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT. CD



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.396	0.000	ELEVON 0.000
x	0.798	0.000	
o	0.996		
d	1.199		
y	2.745		
x	3.479		REFERENCE FILE.

REFERENCE INFORMATION
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REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.406
YHRF 0.000
ZHRF 0.045

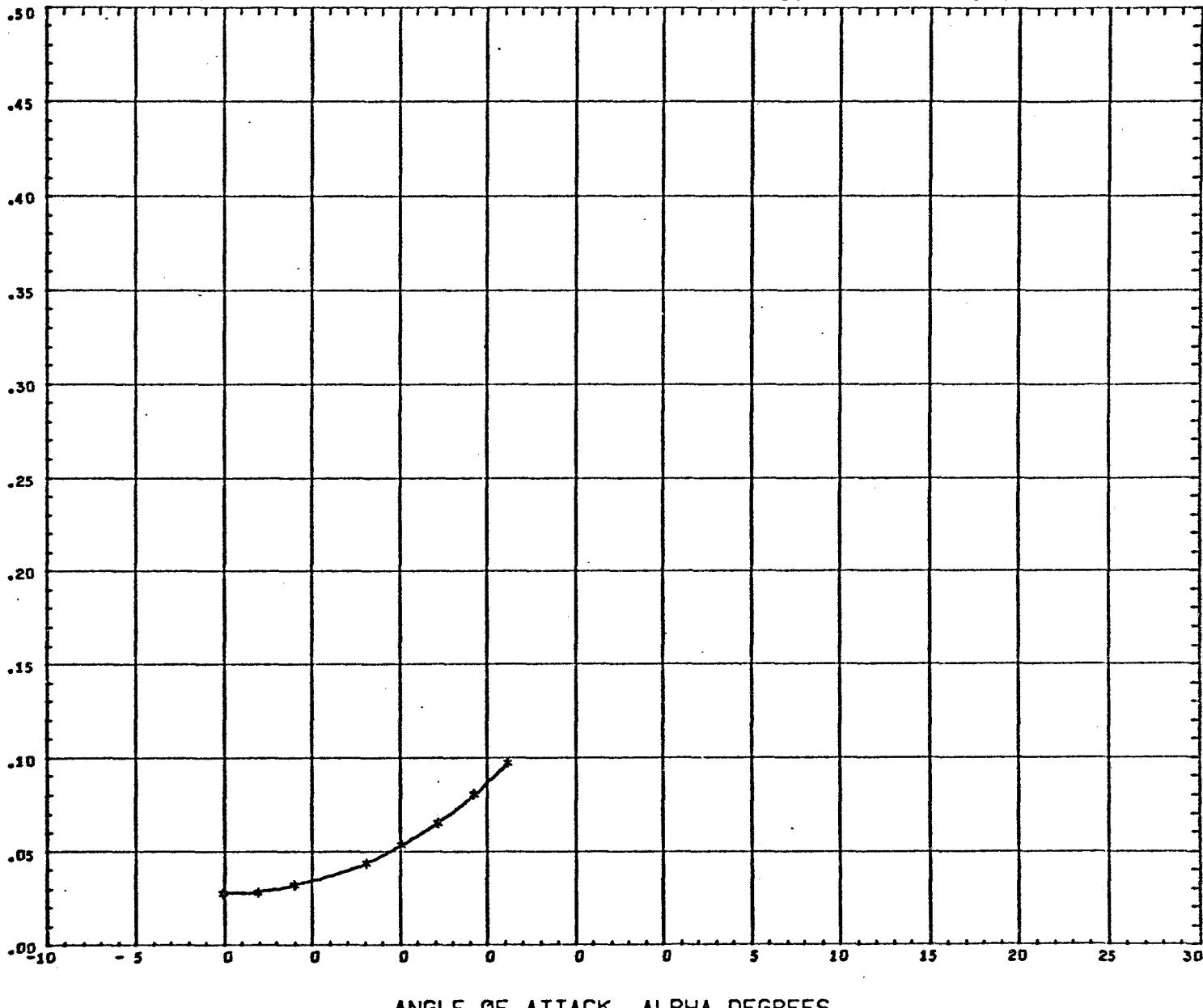
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

(S17025) 02 JUL 70

PAGE

41

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



<b>SYMBOL</b>	<b>MACH</b>	<b>PARAMETRIC VALUES</b>	
*	4.960	BETA	0.000 ELEVON
		RUDDER	0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
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REFS	0.405	FT.
XMRP	0.406	
YMRP	0.999	
ZMRP	0.045	

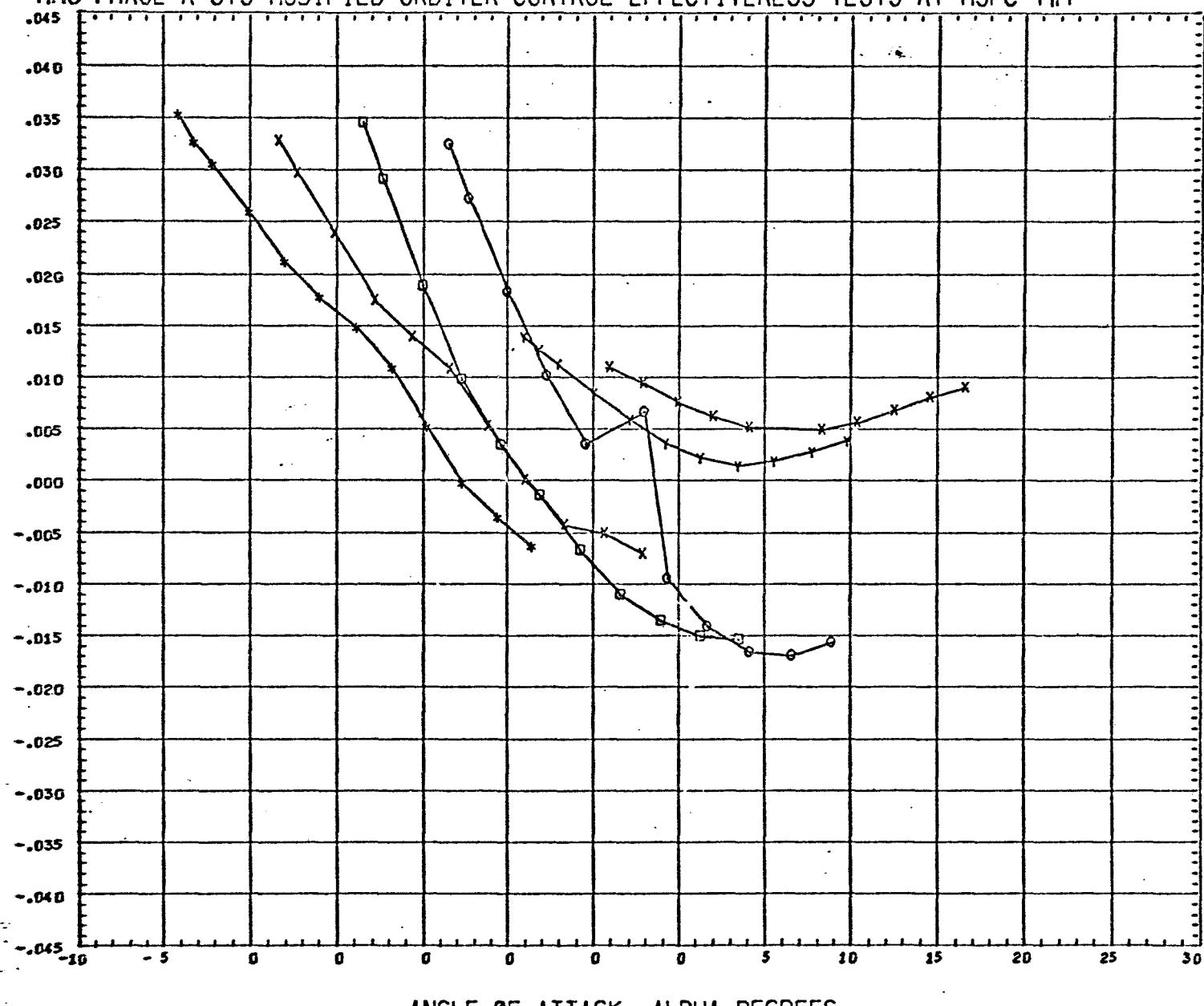
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(S17025) 02 JUL 70 PAGE 42

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



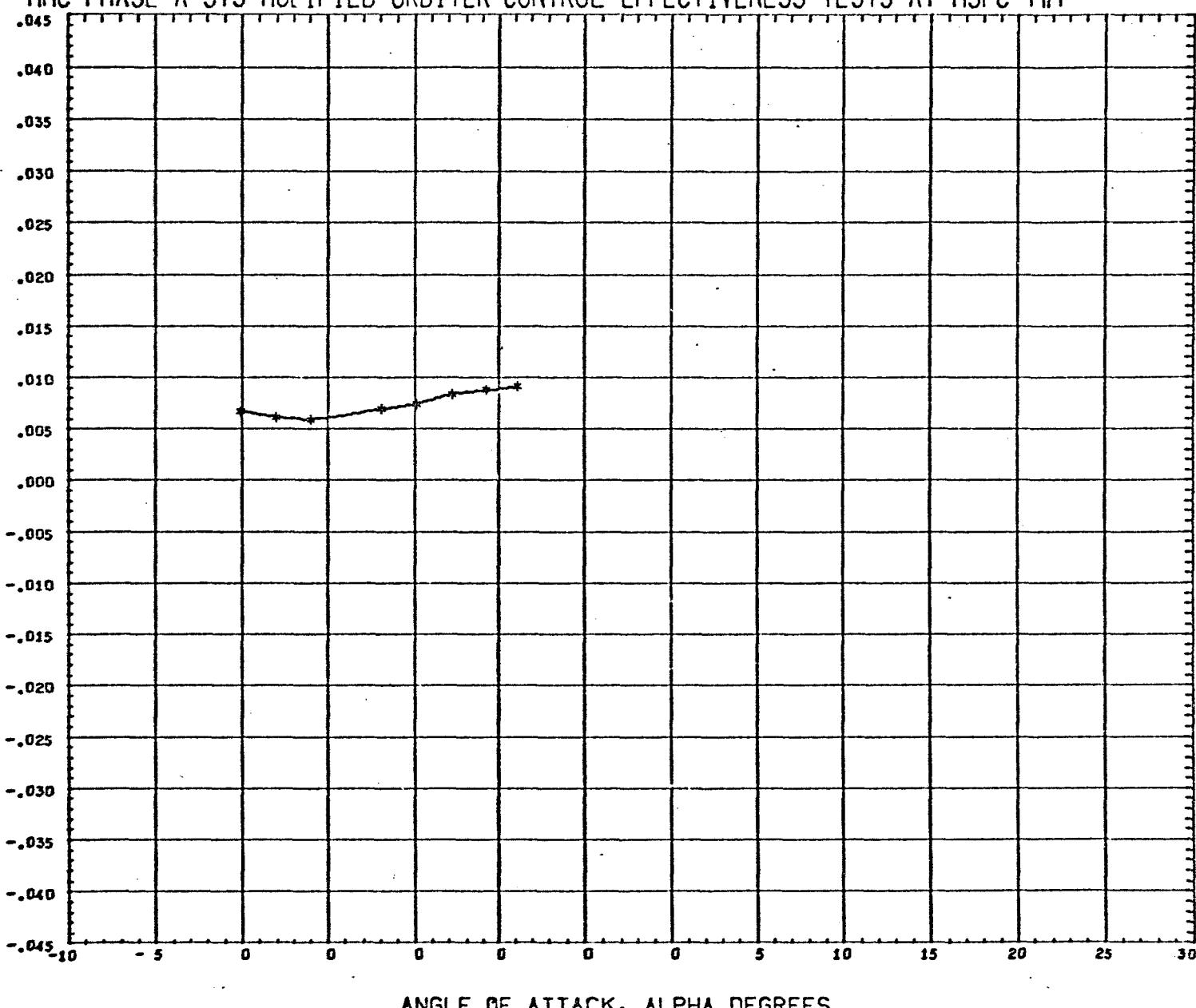
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	6.398		0.000 ELEVON - 15.000
X	6.797	RUDDER	0.000
□	6.997		
○	1.211		
▼	2.740		
×	3.479		REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 4.960 BETA 0.000 ELEVON - 15.000  
RUDDER 0.000

REFERENCE INFORMATION  
REFS 0.116 SQ.FT.  
REFL 0.646 FT.  
REFB 0.405 FT.  
XHRF 0.406  
YHRF 0.000  
ZHRF 0.045

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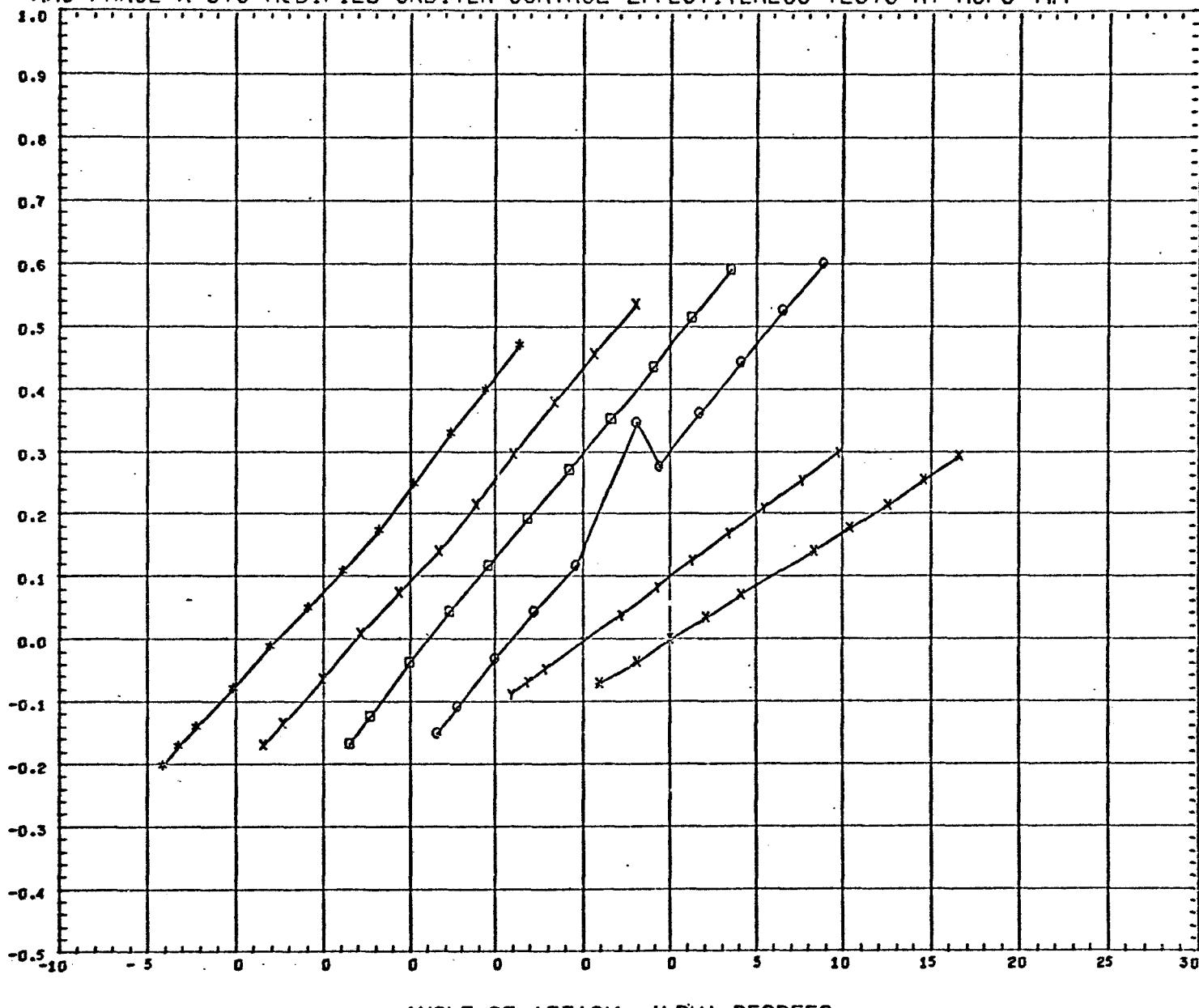
(R17026) 02 JUL 70

PAGE

44

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

NORMAL FORCE COEFFICIENT. CN

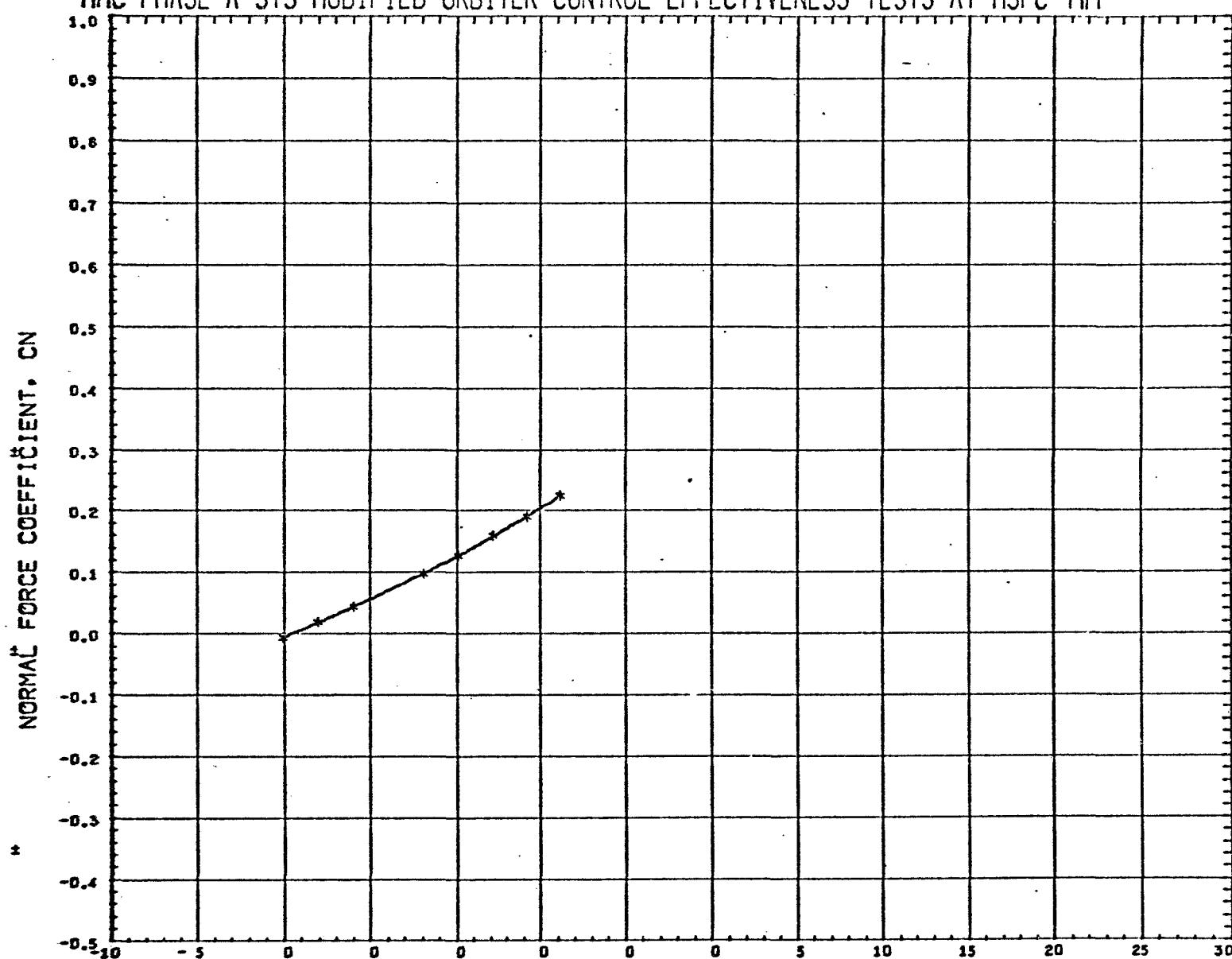


ANGLE OF ATTACK. ALPHA DEGREES

SYMBOL	MACH	PARAMETRIC VALUES
*	0.398	BETA 0.000 ELEVON - 15.000
x	0.797	RUDDER 0.000
o	0.997	
△	1.211	
▽	2.740	
x	3.479	REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 4.960 BETA 0.000 ELEVON - 15.000  
RUDGER 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

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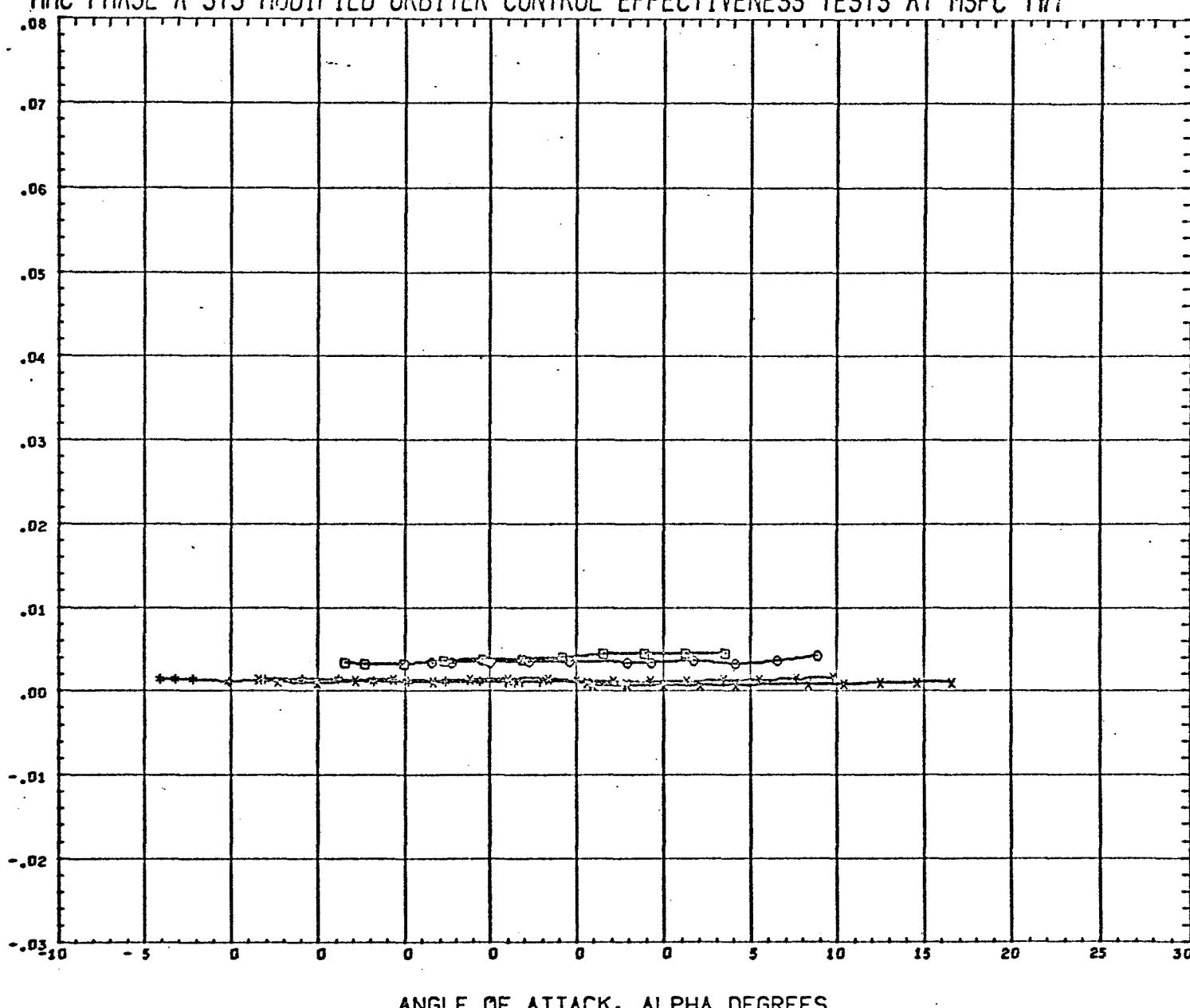
(R17026) 02 JUL 70

PAGE

46

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, CABASE



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.398	5.000	ELEVON - 15.000
x	0.797	0.000	RUDER
o	0.997		
+	1.211		
v	2.740		
x	3.479		REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REF8	0.405	FT.
XHRF	0.406	
YHRP	0.000	
ZHRP	0.045	

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

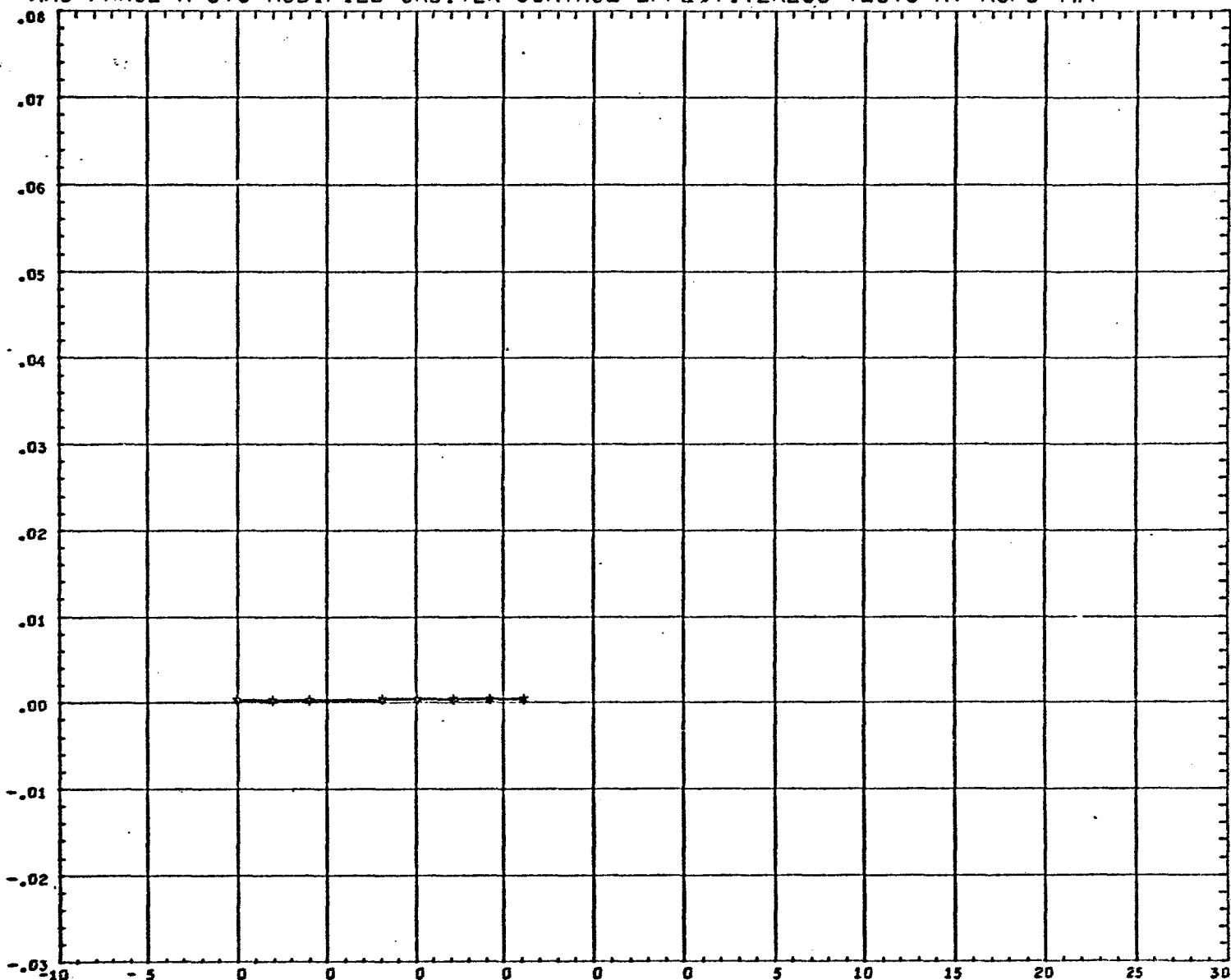
(R17026) 02 JUL 70

PAGE

47

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, CABASE



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 \* 4.960 BETA 0.000 ELEVON - 15.000  
 RUDGER 0.000

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.455	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.043	

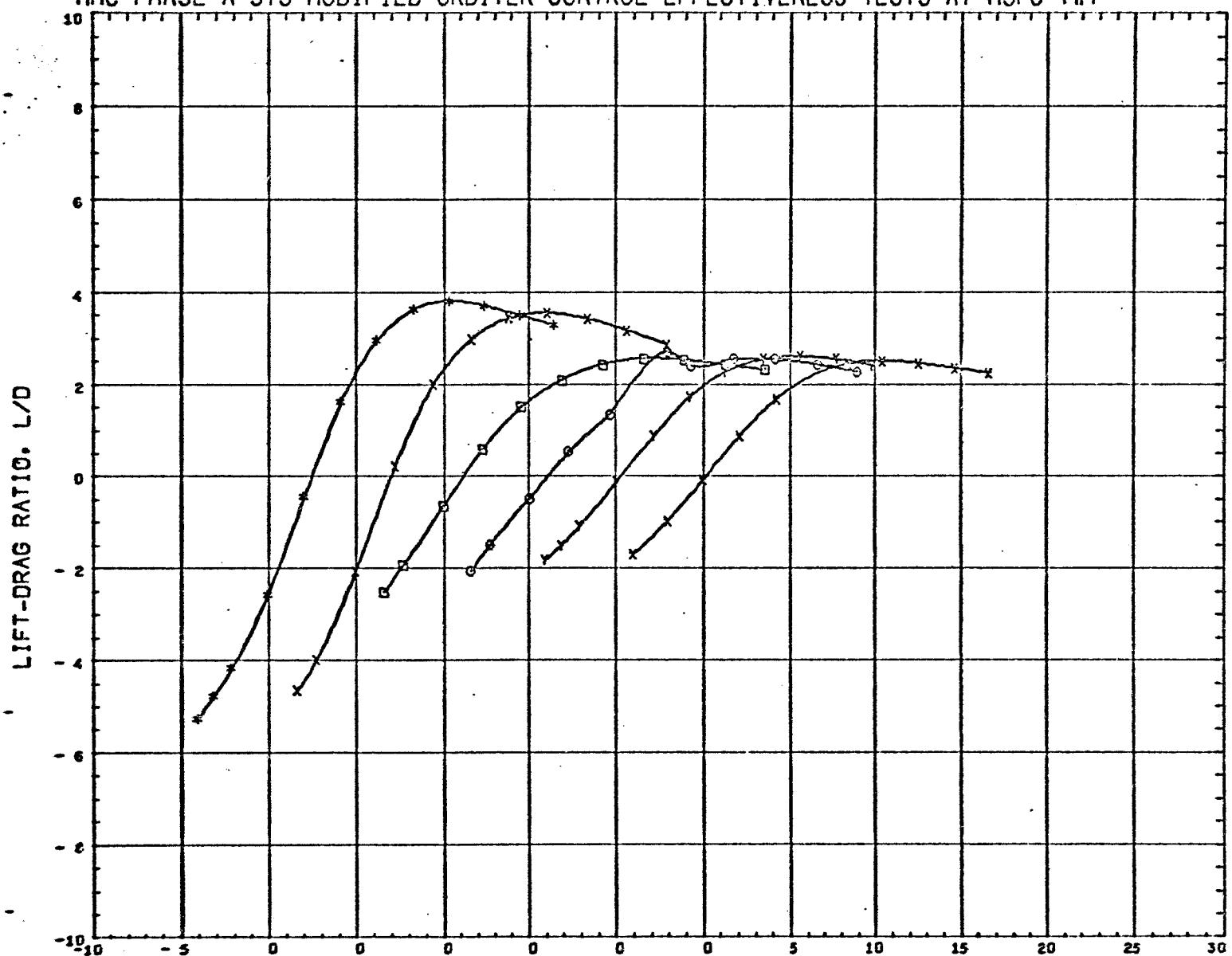
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(R17026) 02 JUL 70

PAGE

48

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

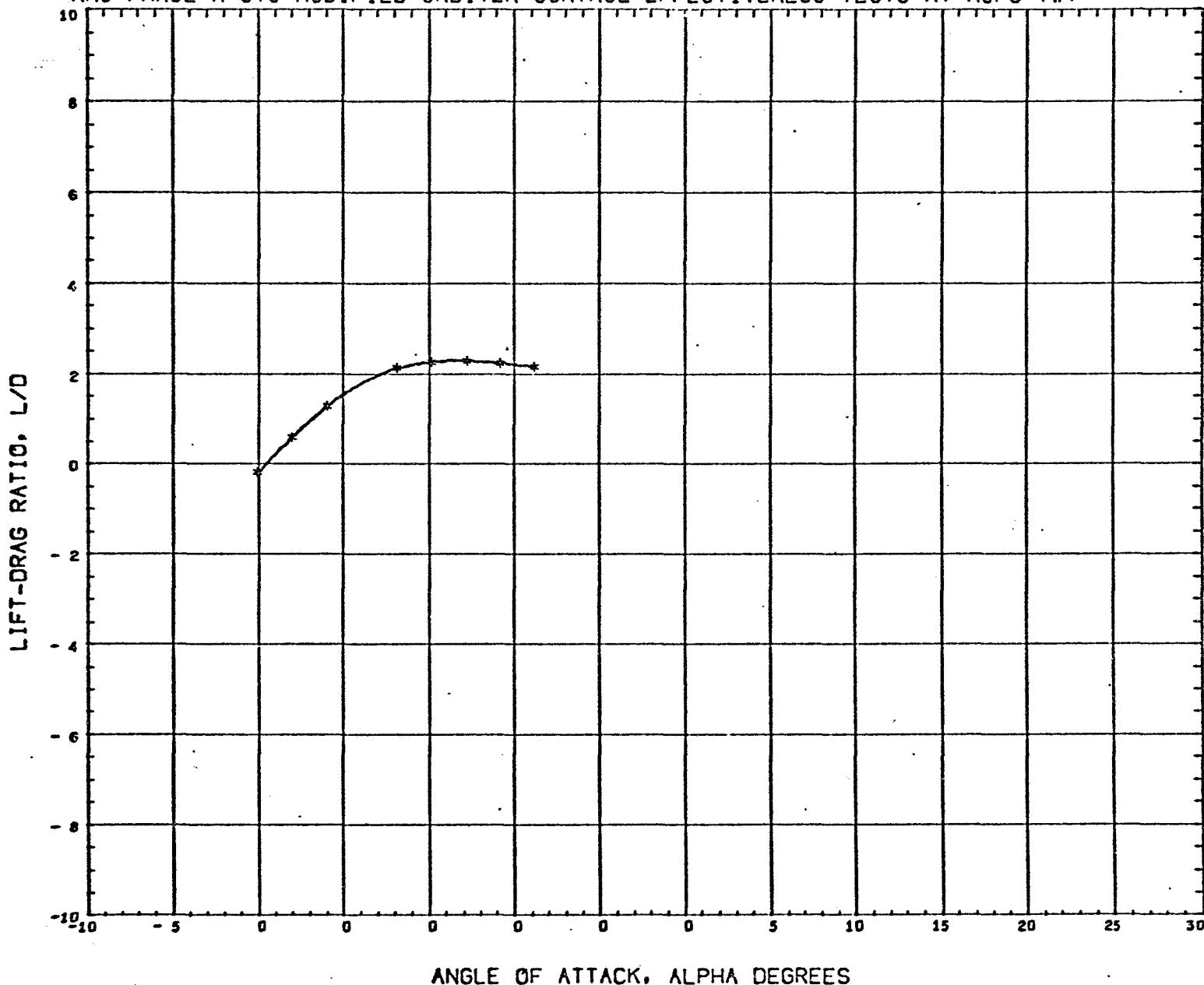


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	PARAMETRIC VALUES		
	MACH	BETA	ELEVON - 15.000
*	0.398	0.000	
x	0.797	0.000	
□	0.997		
○	1.211		
+	2.749		
-	3.479		REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.496	
YHRF	0.005	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 \* 4.965 BETA 0.000 ELEVON - 15.000  
 RUDDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.406  
 YHRF 0.000  
 ZHRF 0.045

REFERENCE FILE.

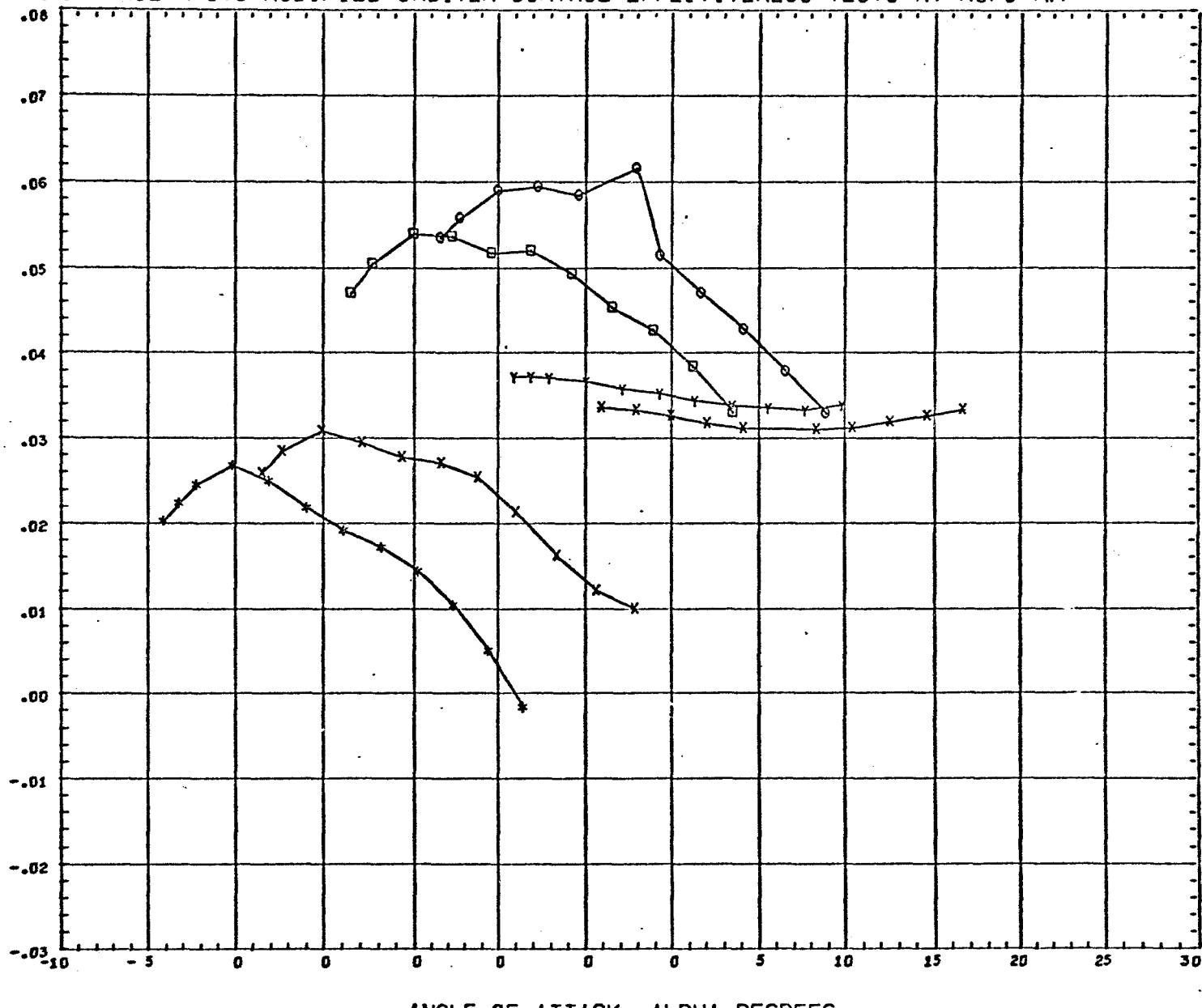
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(R17026) 02 JUL 70

PAGE 50

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAF<sub>0</sub>

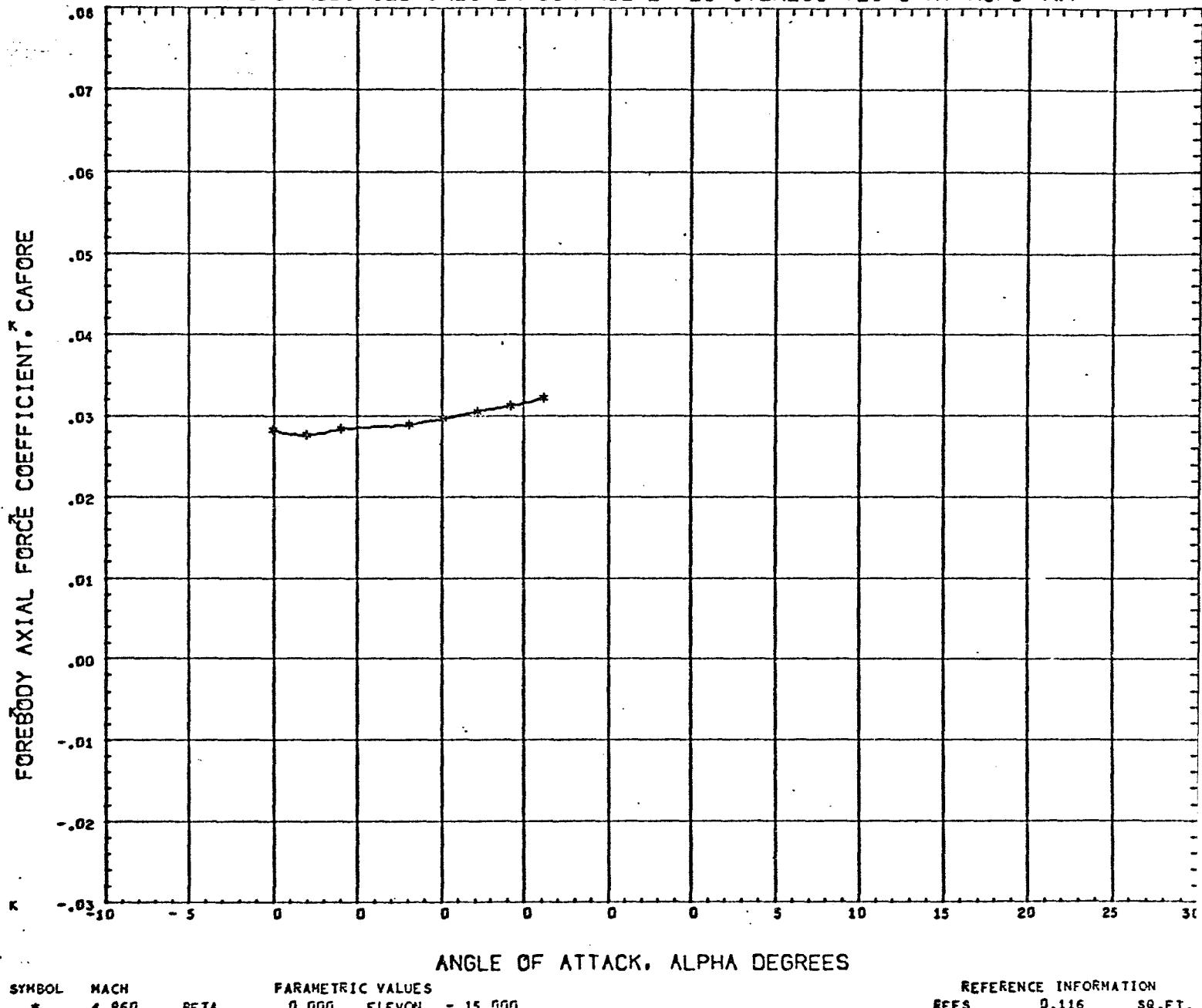


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.398	0.000	ELEVON - 15.000
x	0.797	0.000	
o	0.997		
o	1.211		
y	2.740		
x	3.479		REFERENCE FILE.

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.406
YHRF 0.000
ZHRF 0.045

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL MACH PARAMETRIC VALUES  
 \* 4.969 BETA 0.000 ELEVON - 15.000  
 RUDER 0.000

REFERENCE INFORMATION		
REFS	0.116	SG.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRF	0.045	

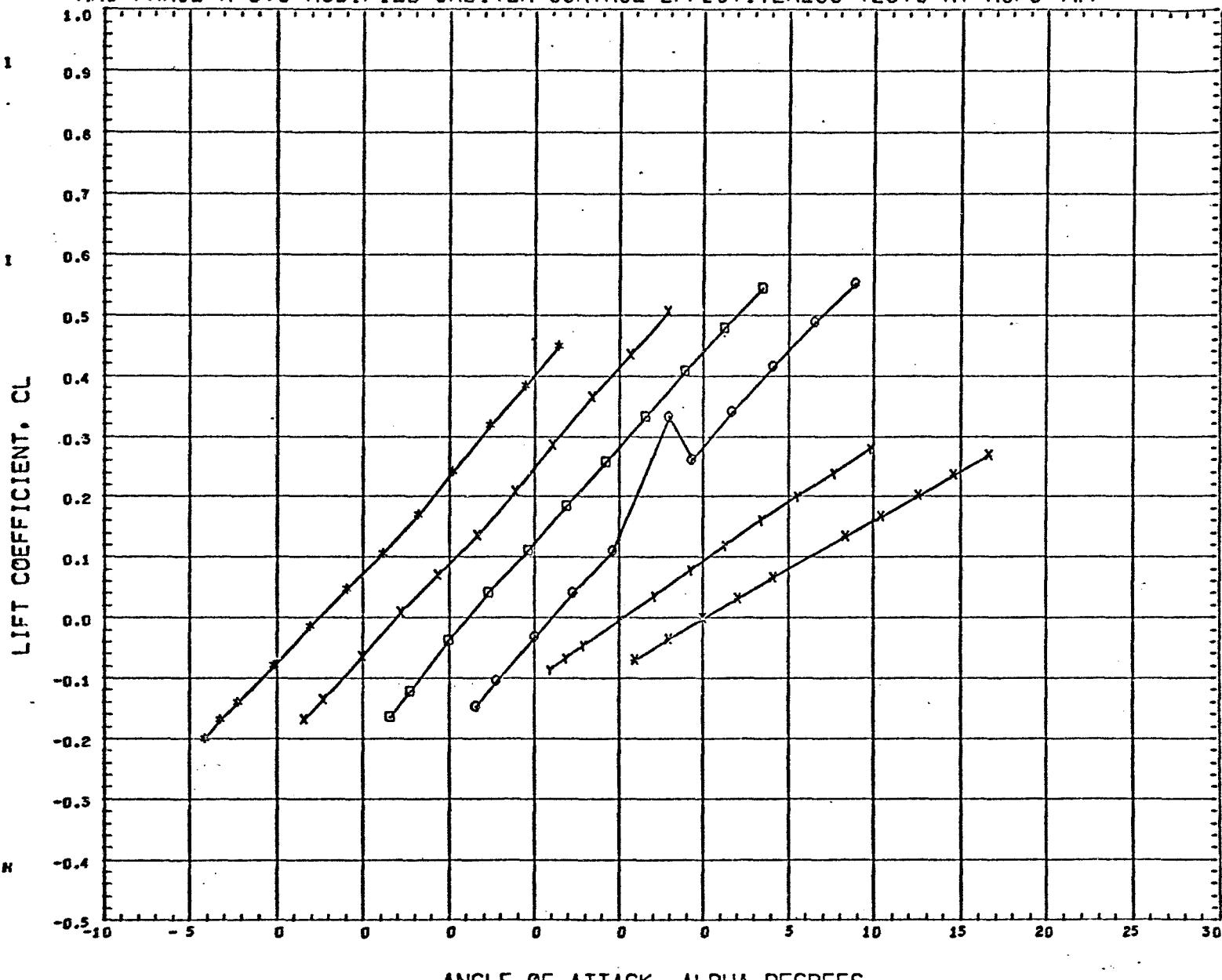
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MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(R17026) 02 JUL 70

PAGE 52

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



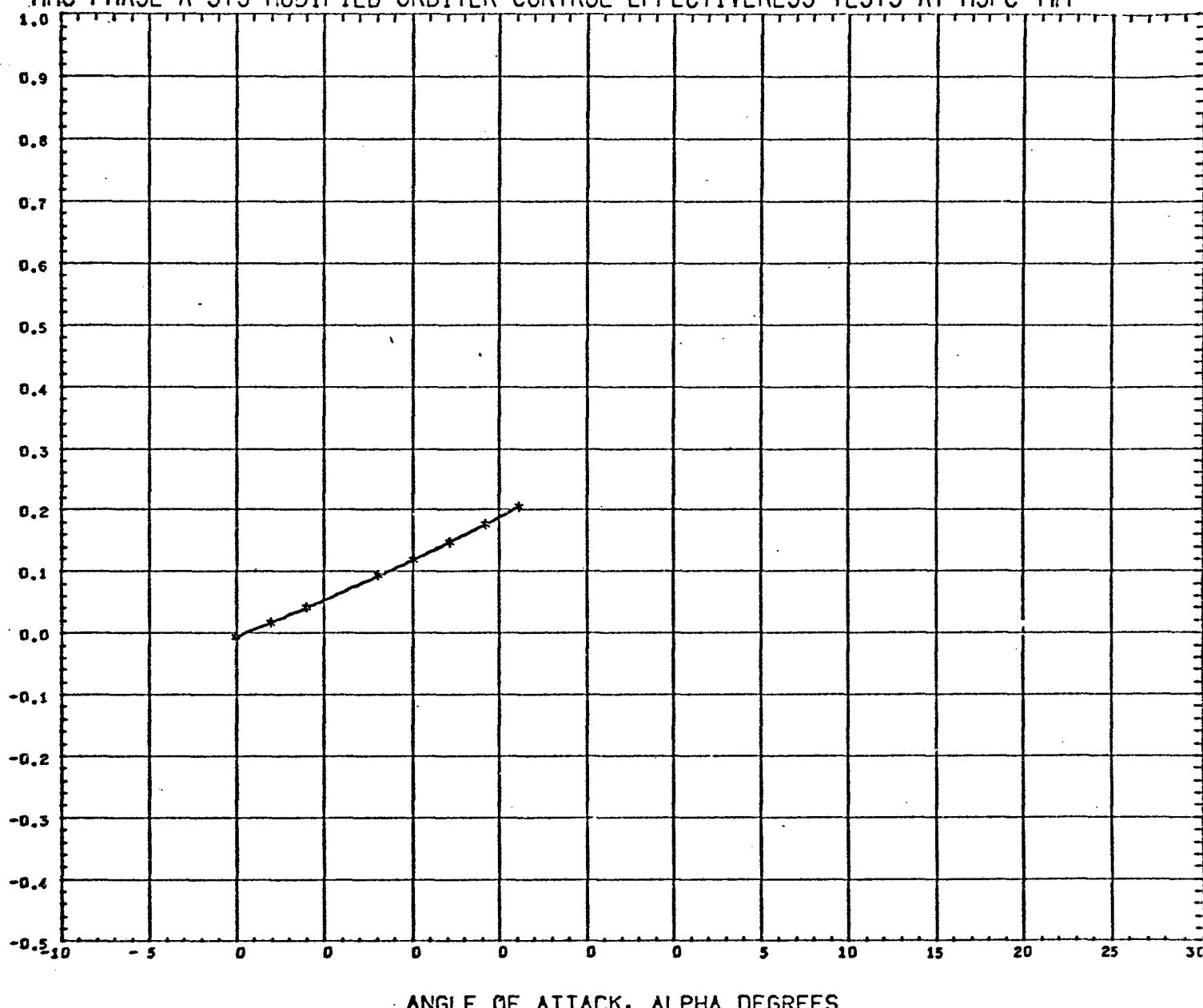
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.398	0.000	ELEVON - 15.000
x	0.797	0.000	
□	0.997		
○	1.211		
▽	2.740		
x	3.479		REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZMRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

LIFT COEFFICIENT, CL



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 ● 4.960 BETA 0.000 ELEVON - 15.000  
 RUDGER 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

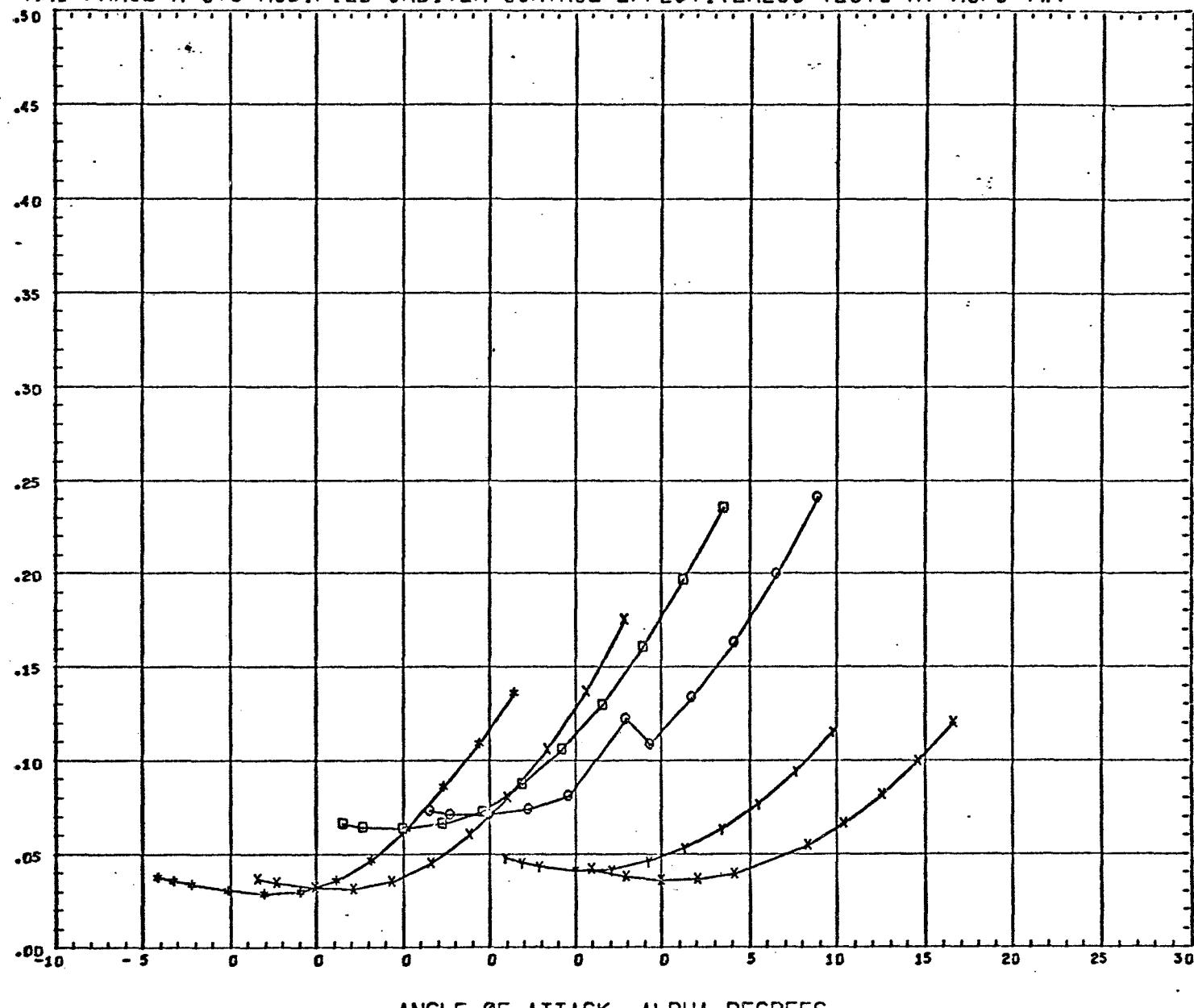
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(S17026) 02 JUL 70

PAGE 54

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT, CD

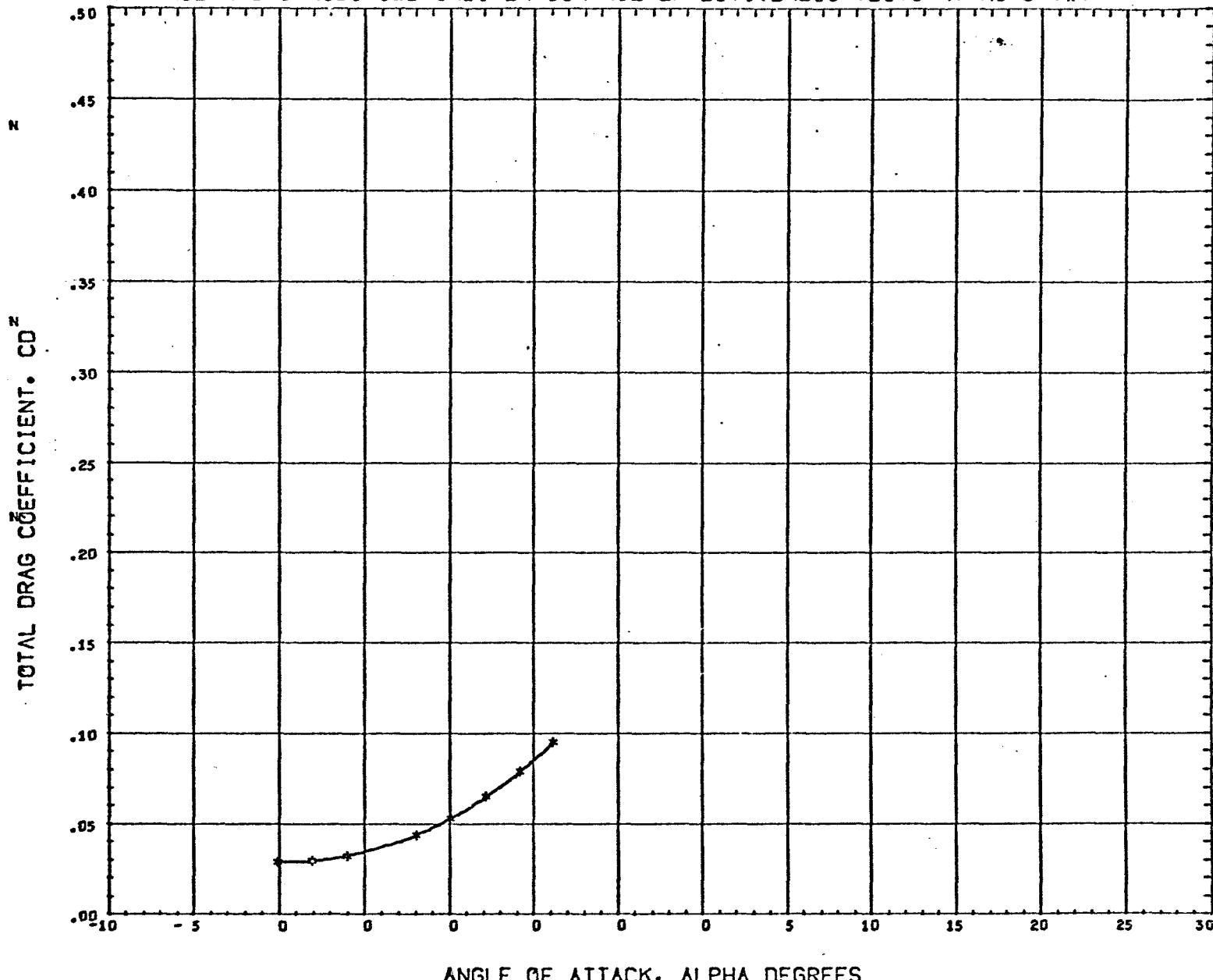


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	PARAMETRIC VALUES	
		BETA	RUDDER
*	0.398	0.000	ELEVON - 15,000
X	0.797	0.000	
□	0.997		
○	1.211		
▽	2.740		
×	3.479		REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL MACH PARAMETRIC VALUES  
 \* 4.965 BETA 0.000 ELEVON - 15,000  
 RUDDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.406  
 YMRF 0.000  
 ZHRF 0.045

REFERENCE FILE.

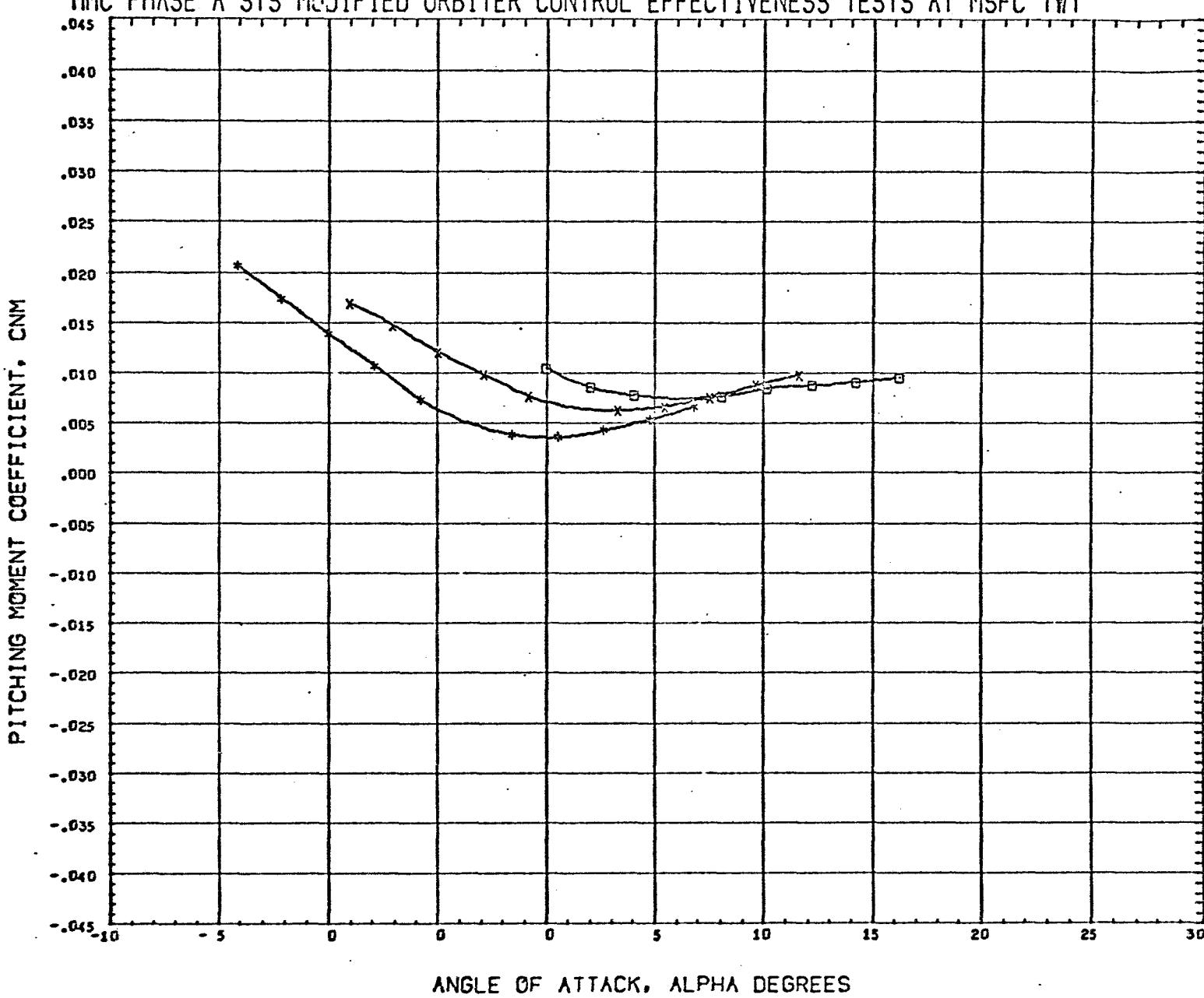
MSFC 453 MMC MOD CRB B2W2T1E1R1 DEL E-15 R0

(S17026) 02 JUL 70

PAGE

56

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH		PARAMETRIC VALUES
•	2.745	BETA	9,000 ELEVON - 30,000
x	3.479	RUDDER	0,000
G	4.960		

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

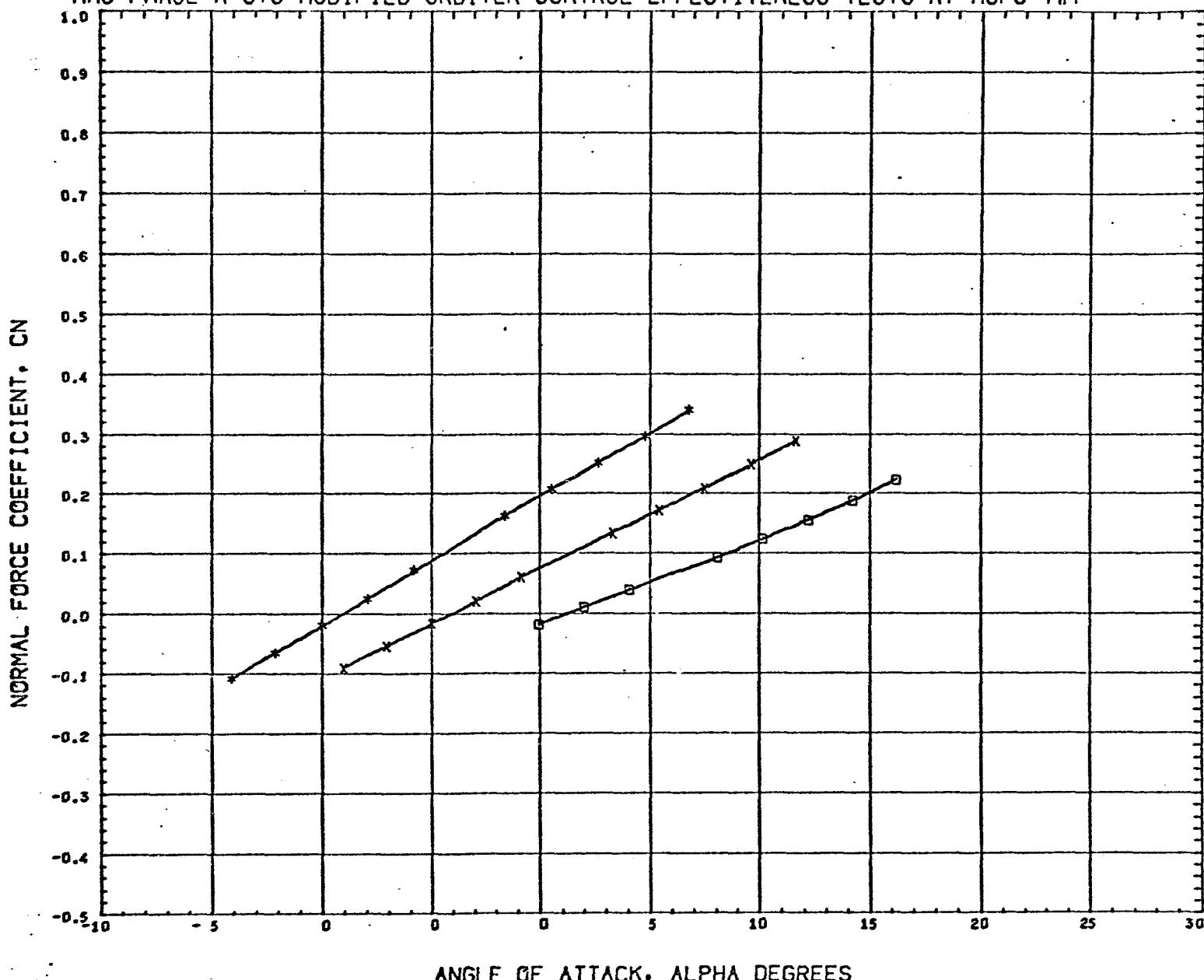
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 RO

(R17027) 02 JUL 70

PAGE

57

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK. ALPHA DEGREES**

SYMBOL	MACH		PARAMETRIC VALUES	
•	2.749	BETA	0.000	ELEVON - 36.000
X	3.479	RUDDER	0.000	
G	4.969			

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

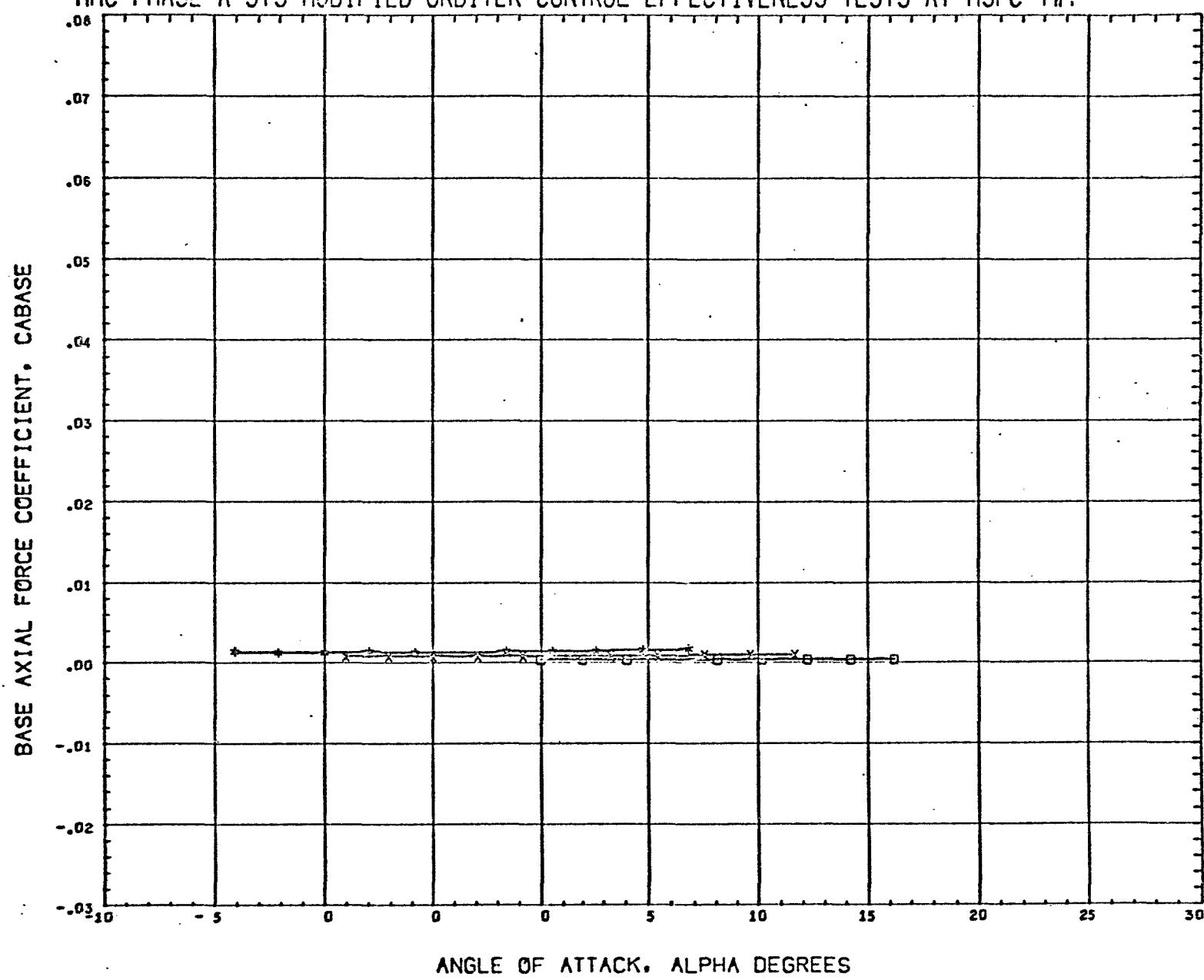
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17027) 02 JUL 70

PAGE

58

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK. ALPHA DEGREES**

SYMBOL	MACH		PARAMETRIC VALUES
●	2.749	BETA	0.000 ELEVON - 30.000
X	3.479	RUDDER	0.000
◎	4.969		

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YMRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

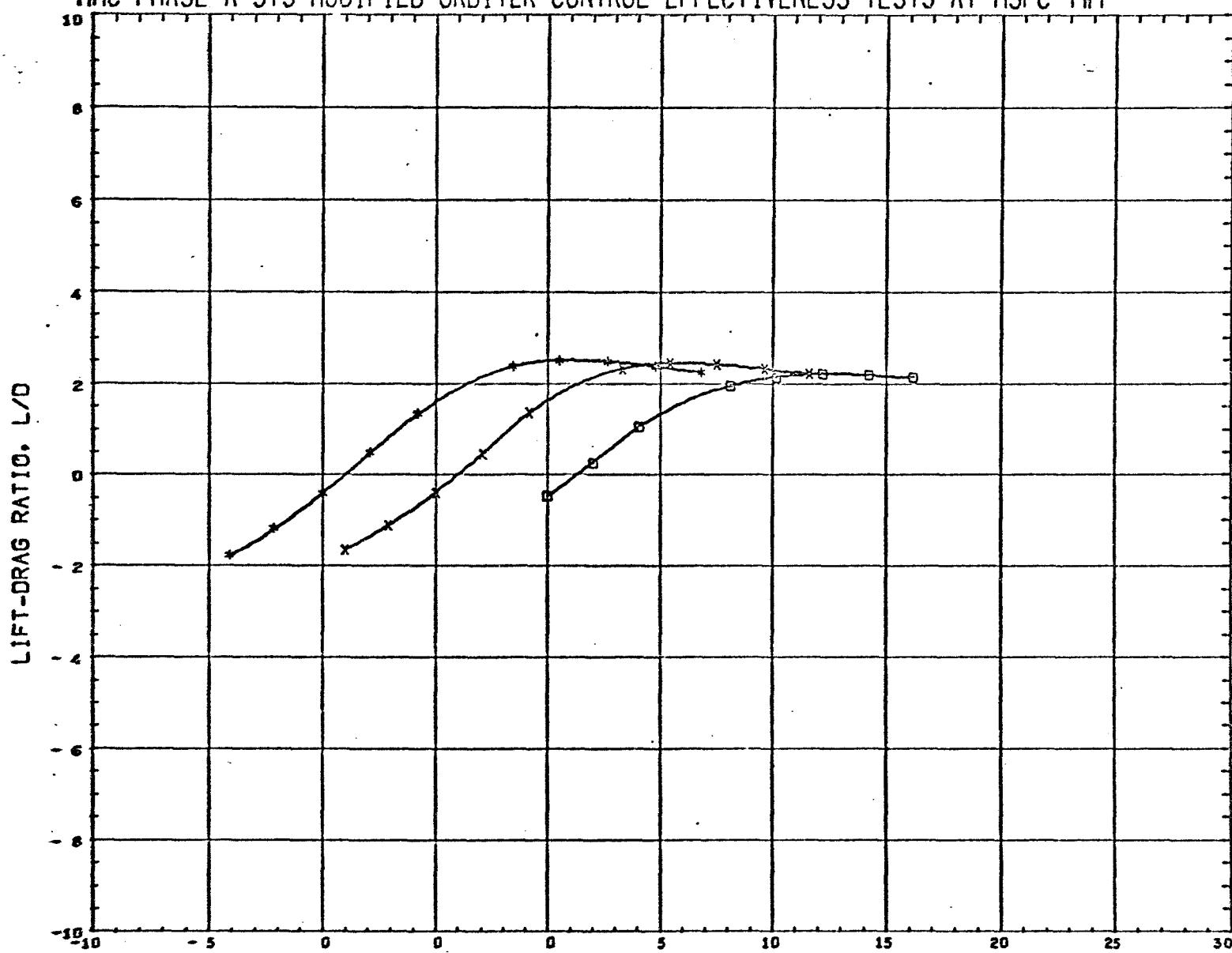
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17027) 02 JUL 70

PAGE

59

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

PARAMETRIC VALUES  
 SYMBOL MACH BETA ELEVON  
 \* 2.749 0.000 -30.000  
 X 3.479 RUDER 0.000  
 G 4.960

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.495	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

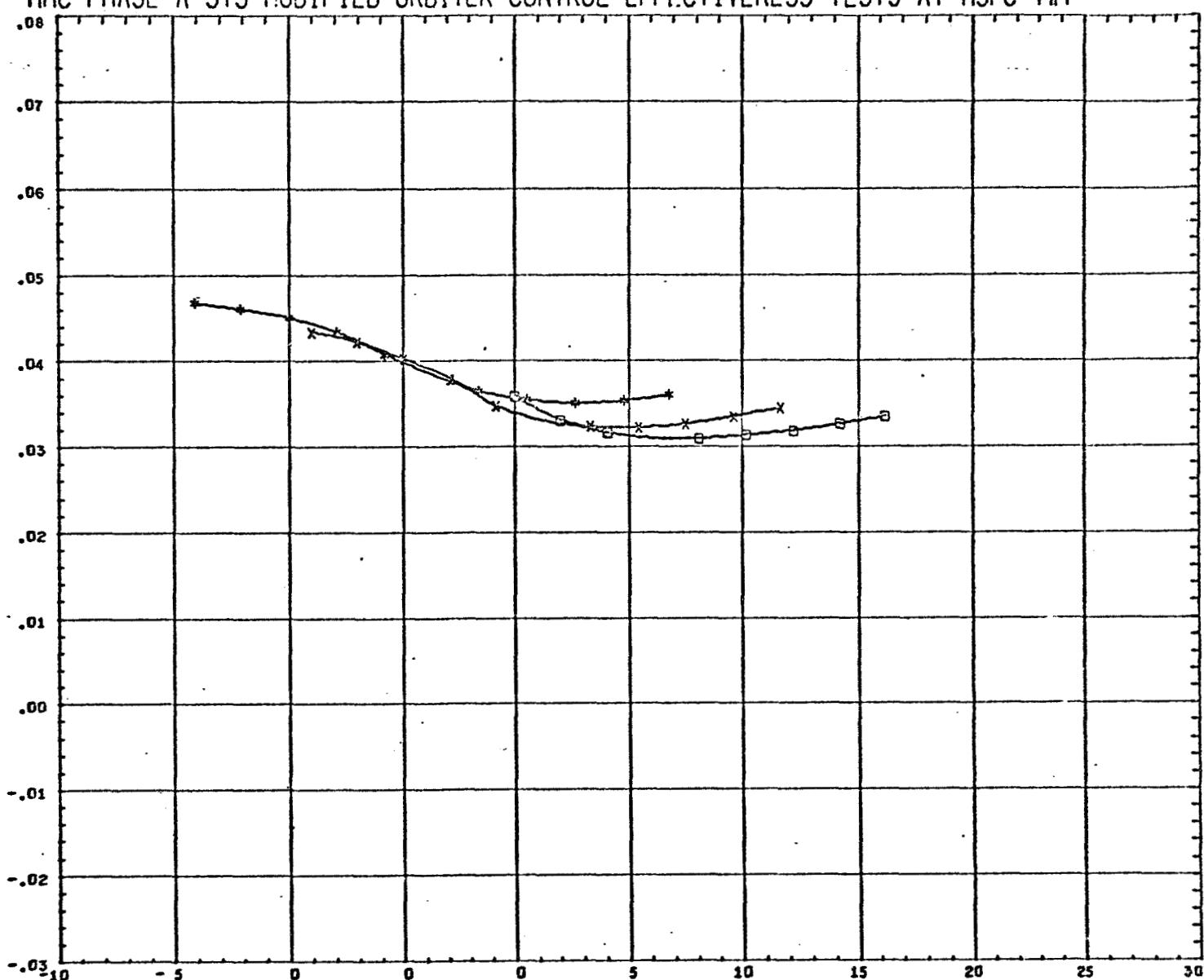
(R17027) 02 JUL 70

PAGE

60

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, C<sub>AFORE</sub>



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	2.740	0.000	ELEVON - 35.000
x	3.479	0.000	
□	4.960		

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

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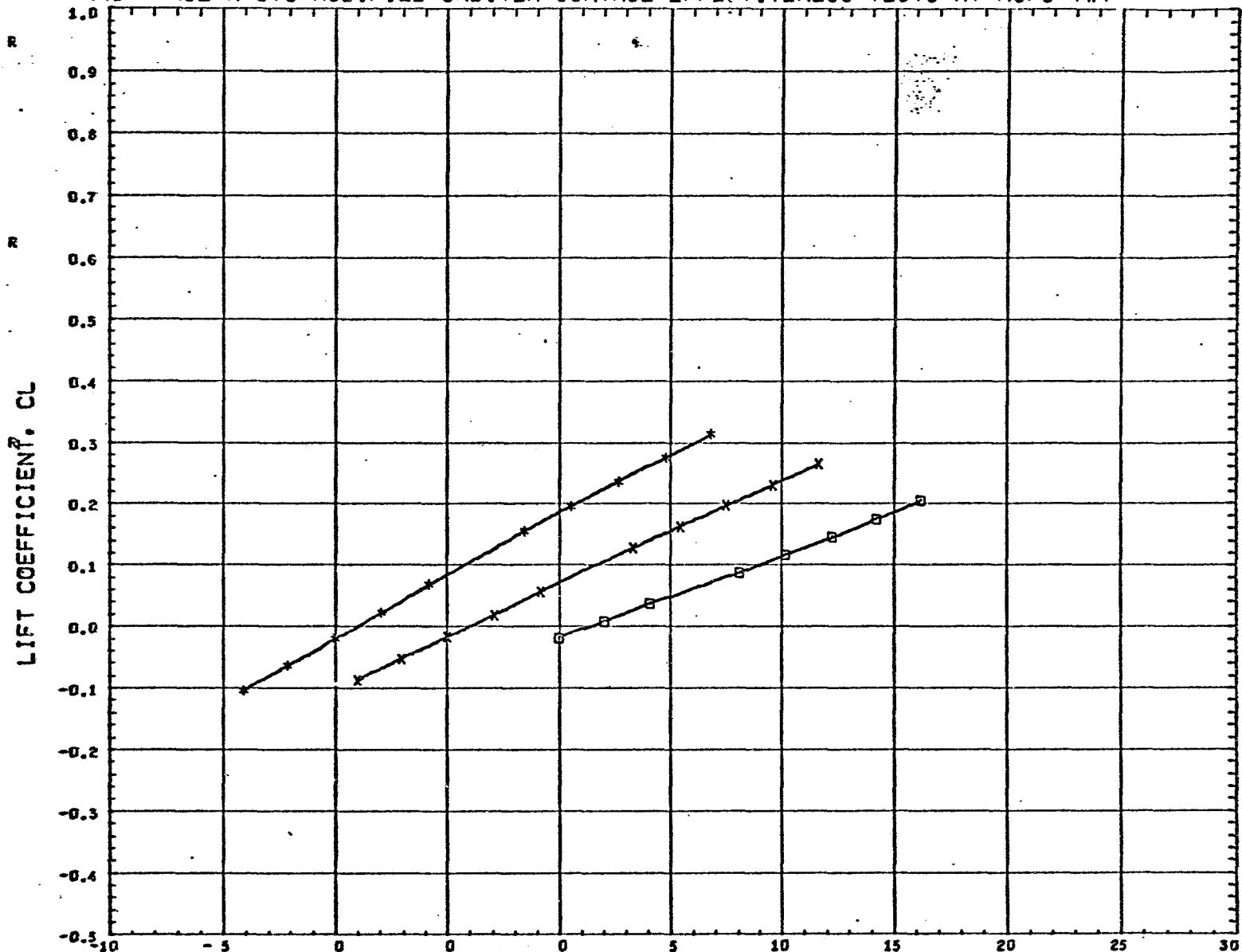
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17027) 02 JUL 70

PAGE

61

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES	ELEVON	- 30,000
•	2.740		0.000		
x	3.479	RUDER	0.000		
□	4.960				

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	F1.
XHRF	0.496	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

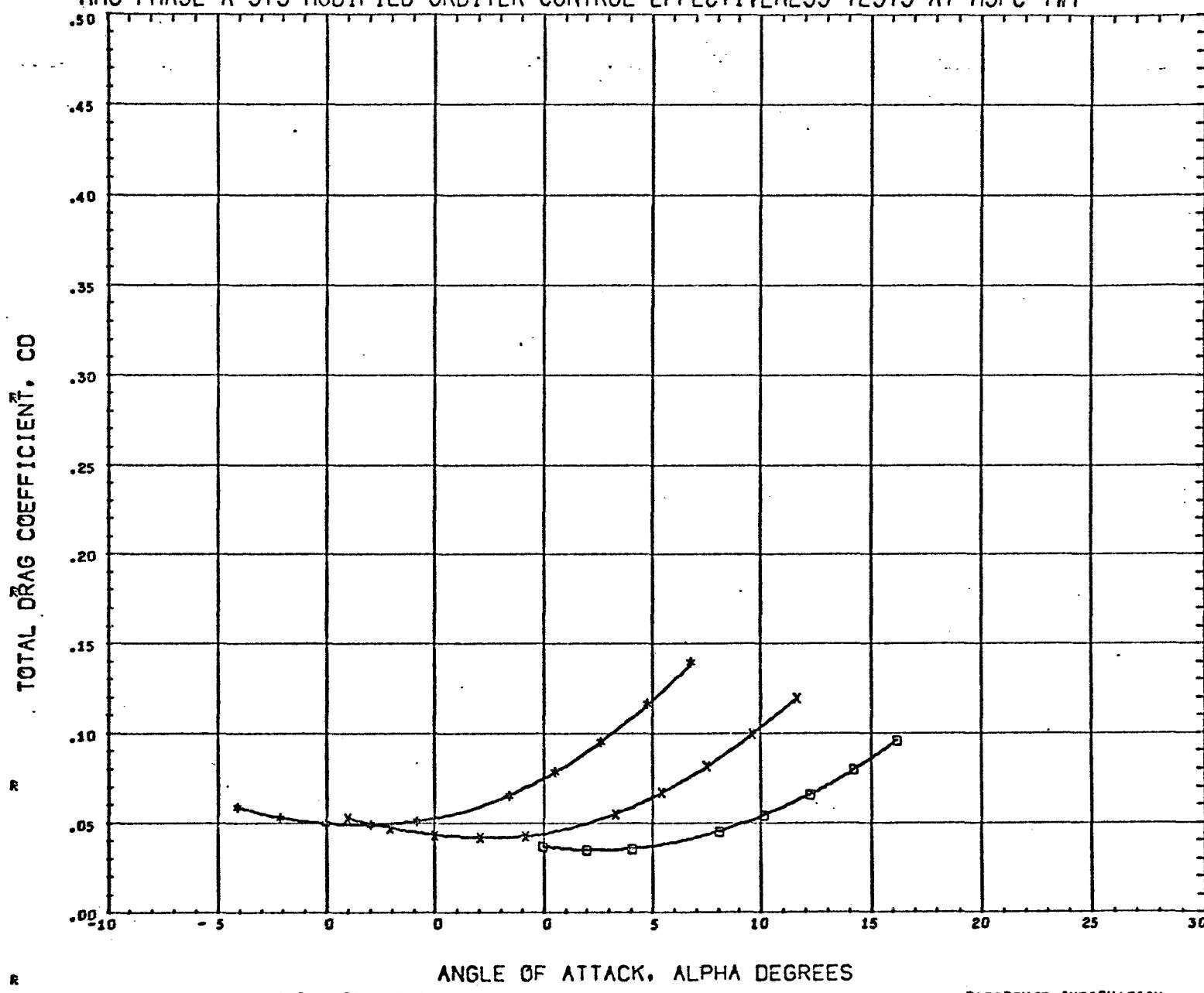
MSFC 453 MMC MOD ORB B2W2T1E1RI DEL E-30 R0

(S17027) 02 JUL 70

PAGE

62

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



R				
SYMBOL	MACH		PARAMETRIC VALUES	
*	2.740	BETA	0.000	ELEVON
X	3.479	RUDDER	0.000	
G	4.960			

### ANGLE OF ATTACK, ALPHA DEGREES

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

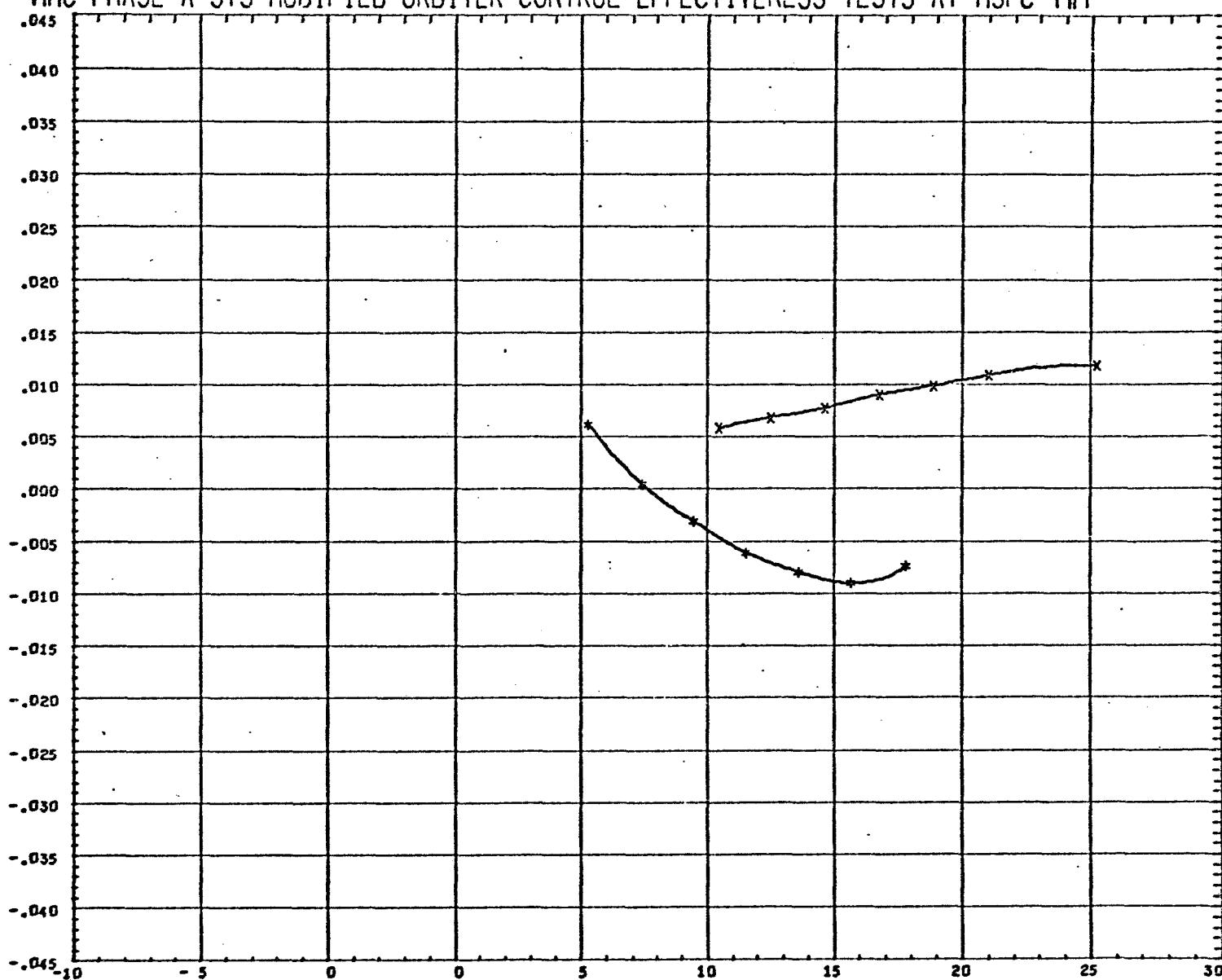
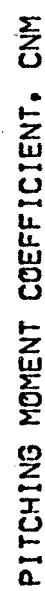
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(S17027) 02 JUL 70

PAGE

63

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK, ALPHA DEGREES**

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.398		0.000 ELEVON - 15,000
x	3.479	RUDDER	0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

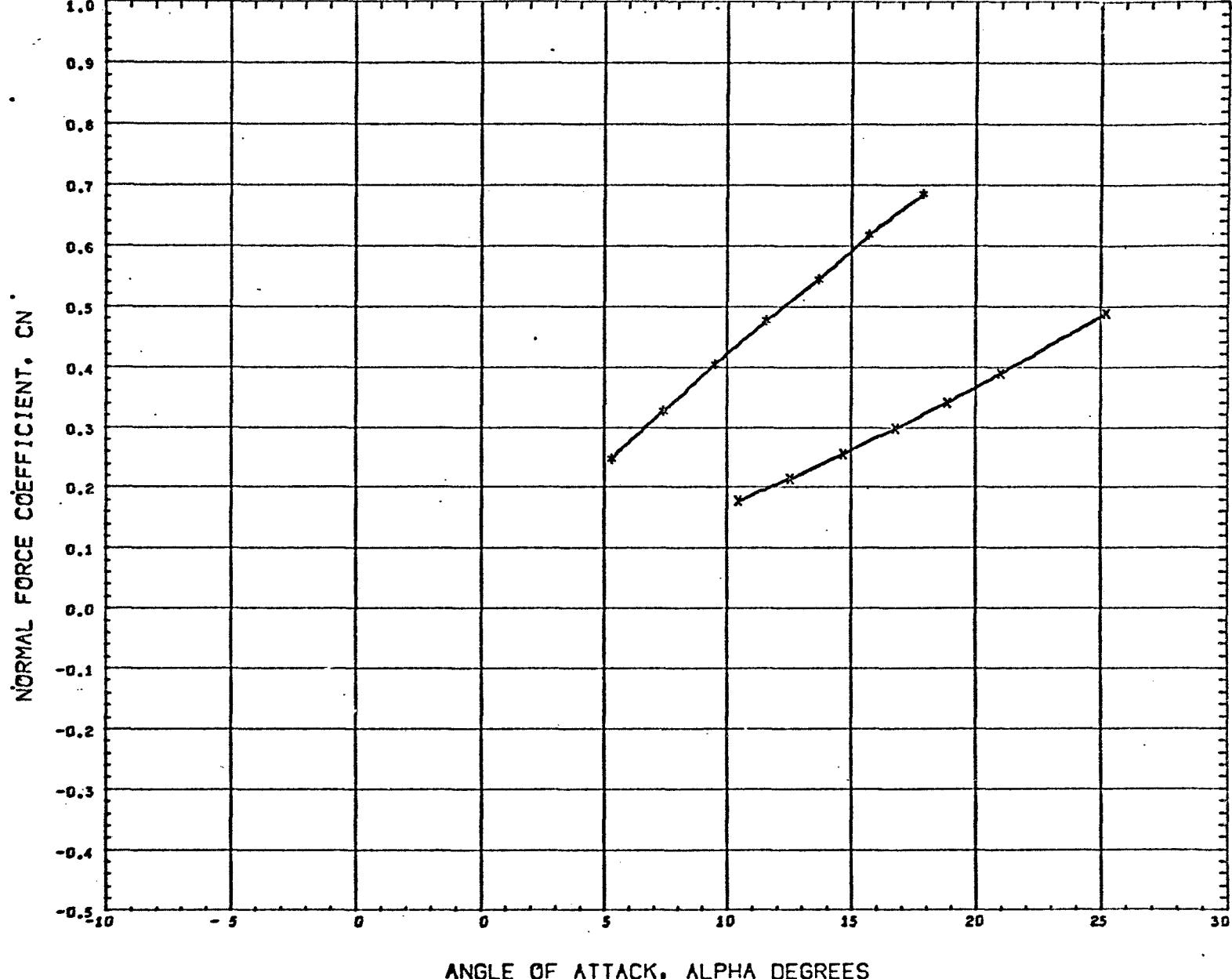
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 RO

(R17028) 02 JUL 70

PAGE

64

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK. ALPHA DEGREES**

SYMBOL	MACH		PARAMETRIC VALUES
*	0.398	BETA	0.000 ELEVON - 15.000
x	3.479	RUDDER	0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.456	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE**

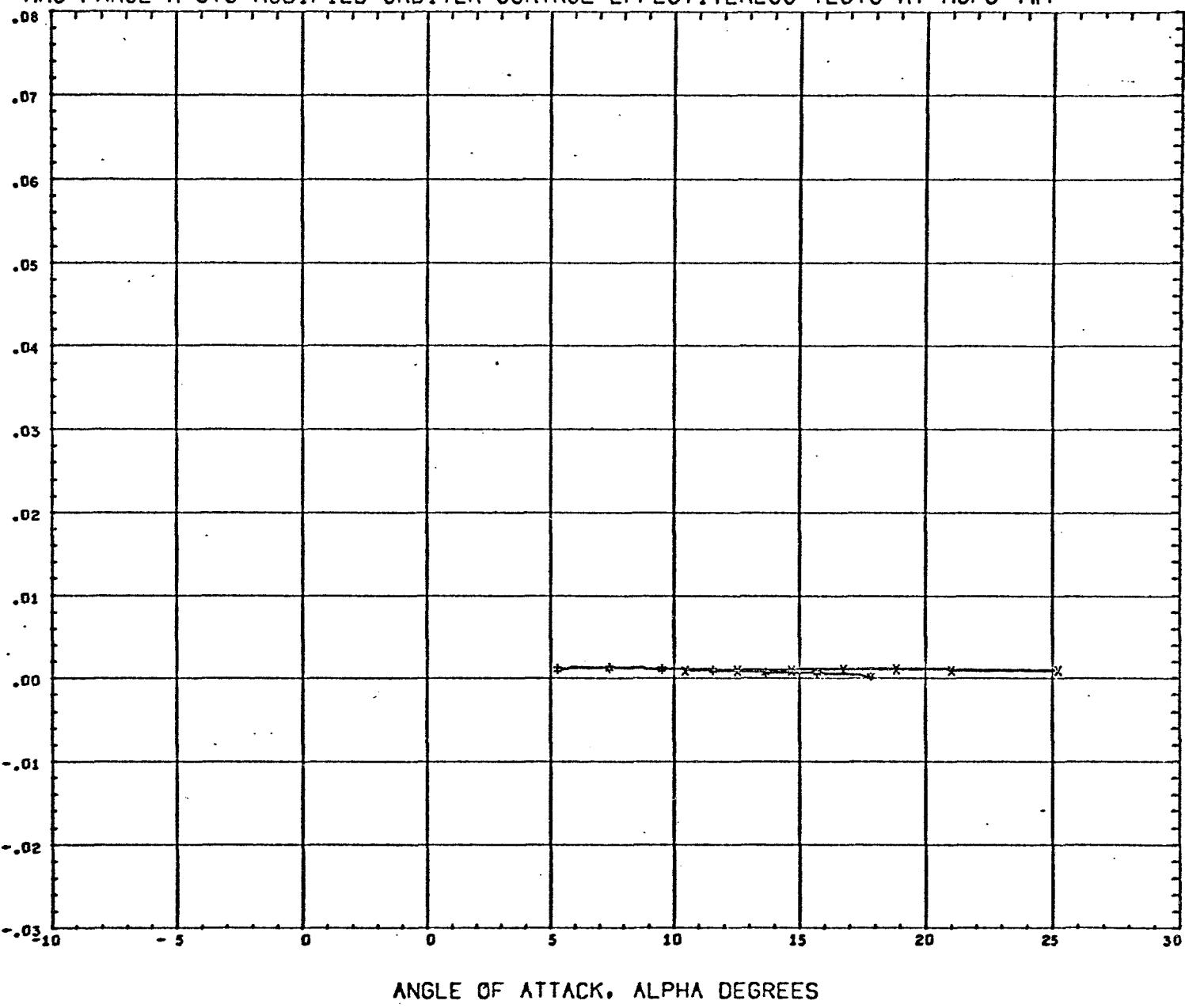
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(R17028) 02 JUL 70

PAGE

65

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH	PARAMETRIC VALUES		
*	0.398	BETA	0.000	ELEVON - 15.000
x	3.479	RUDDER	0.000	

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

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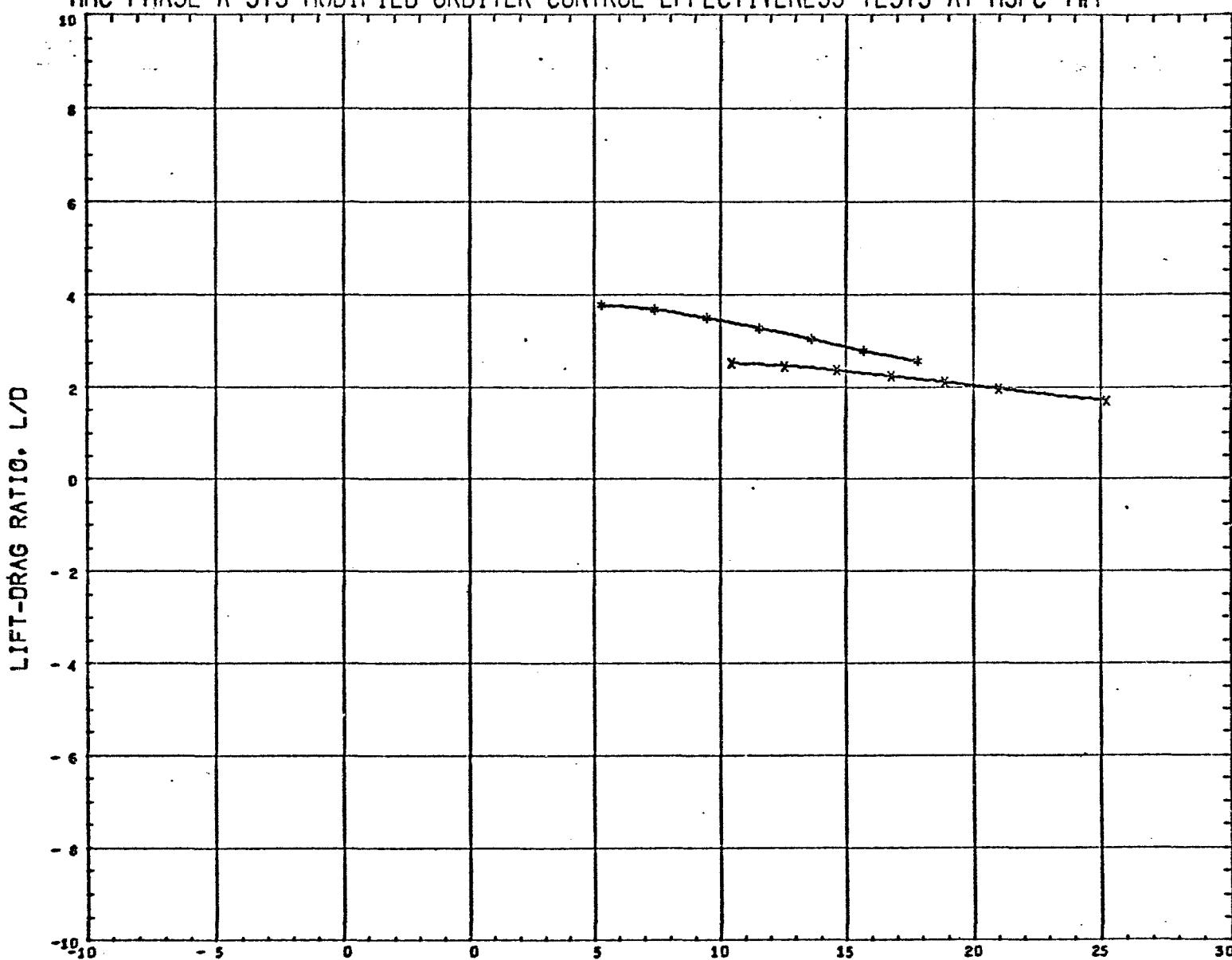
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(R17028) 02 JUL 70

PAGE

65

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.398	0.000	ELEVON - 15.000
x	3.479	0.000	RUDER

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

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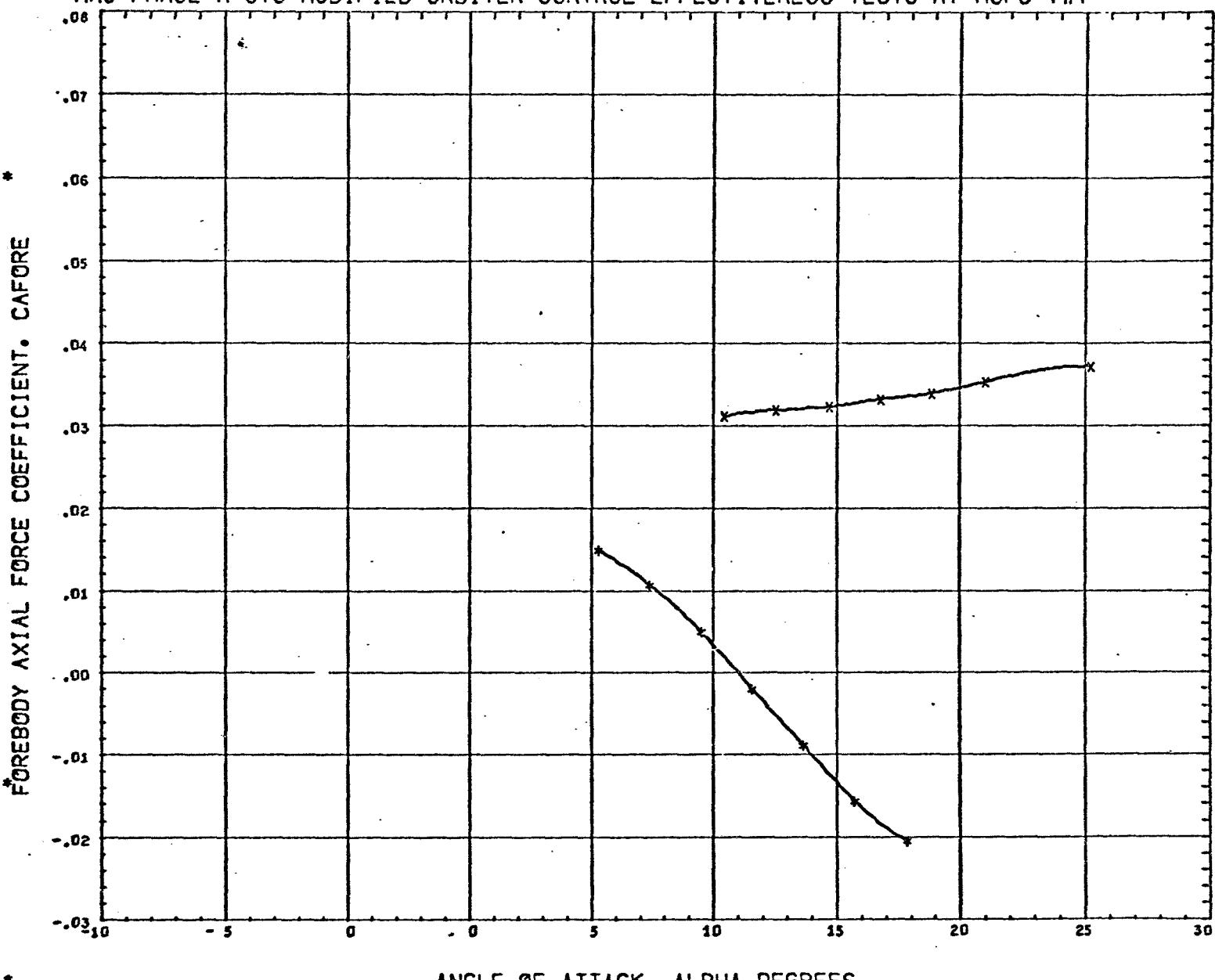
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(R17028) 02 JUL 70

PAGE

67

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

PARAMETRIC VALUES  
 \* MACH 0.398      BETA 0.000      ELEVON - 15.000  
 x RUDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.406  
 YHRF 0.000  
 ZHRF 0.045

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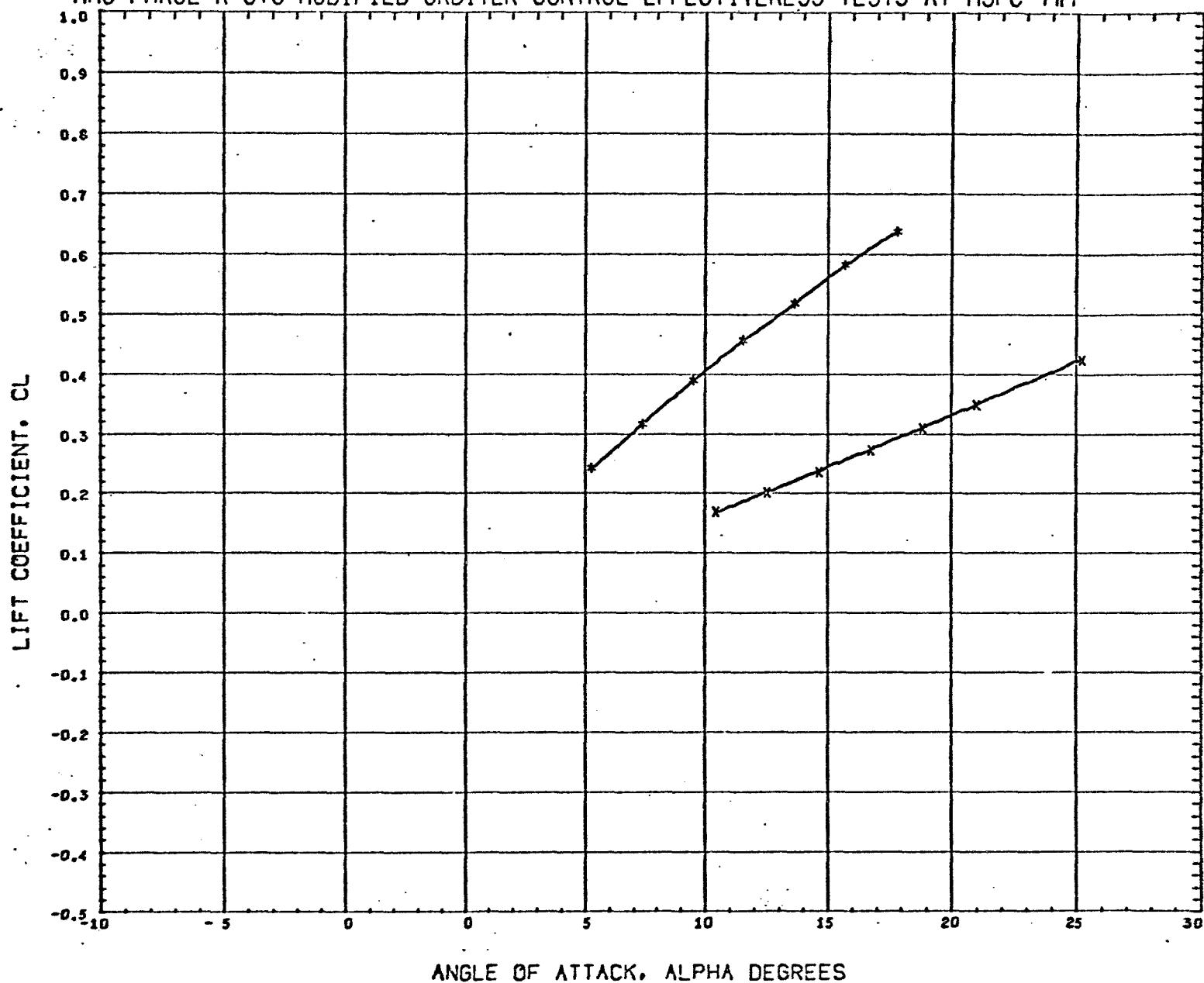
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(R17028) 02 JUL 70

PAGE

68

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.398		0.000 ELEVON - 15.000
x	3.479	RUDDER	0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

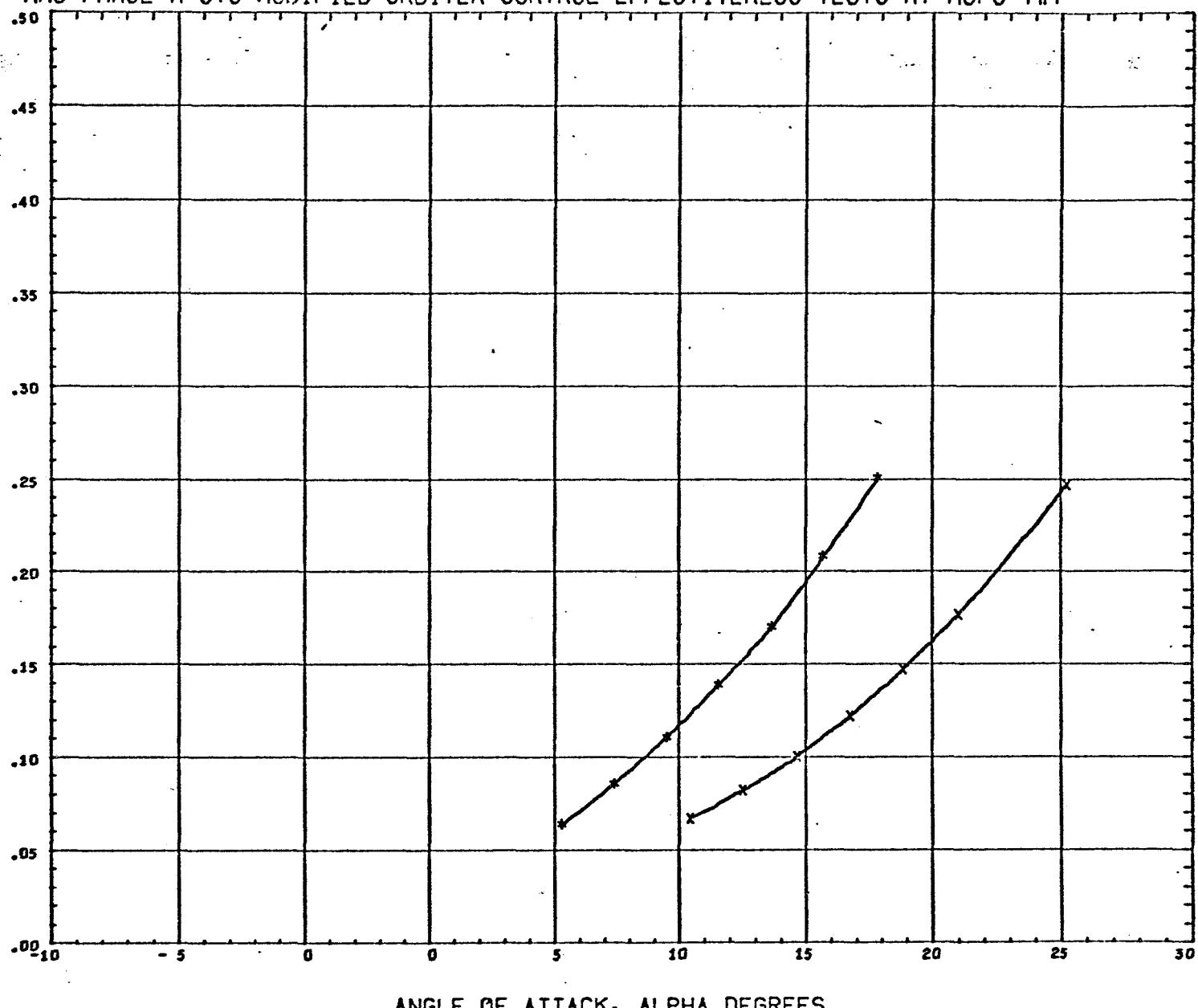
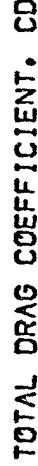
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(S17028) 02 JUL 70

PAGE

69

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**ANGLE OF ATTACK. ALPHA DEGREES**

SYMBOL	MACH	BETA	PARAMETRIC VALUES
•	0.393		0.000 ELEVON - 15.000
x	3.479	RUDER	0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE

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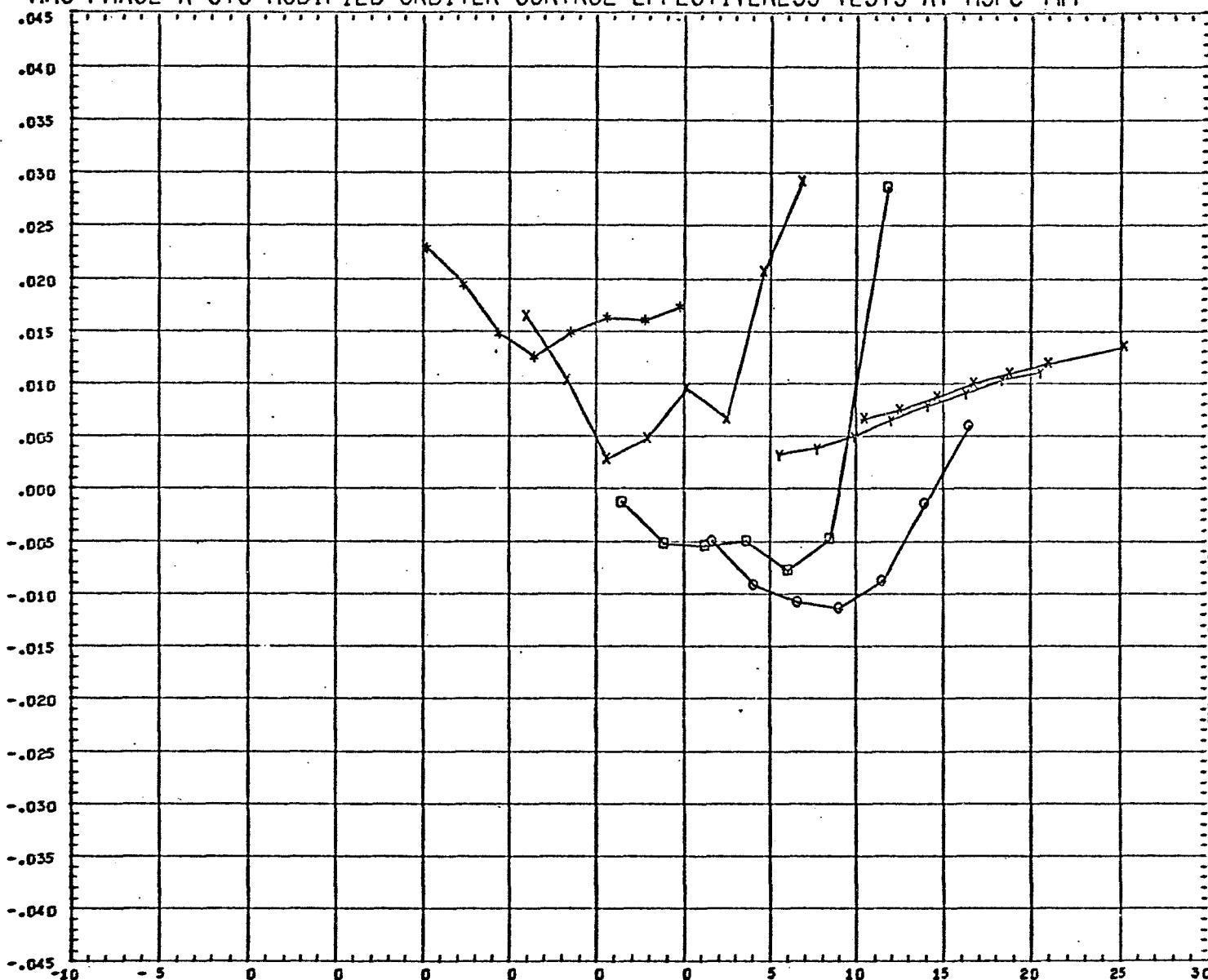
(S17028) 02 JUL 70

PAGE

70

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CM



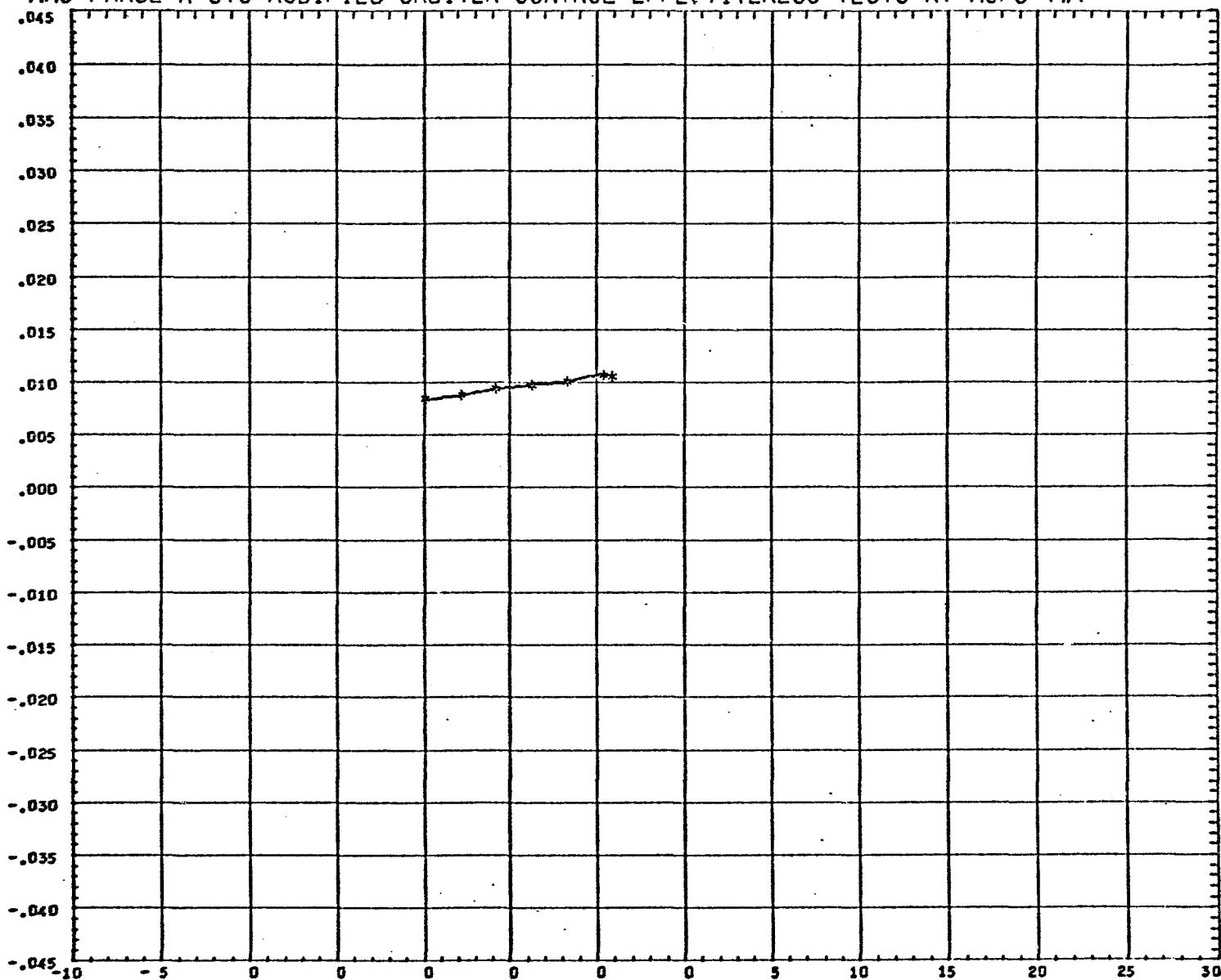
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
•	0.395	0.000	ELEVON - 30.000
x	0.794	0.000	
□	0.995		
○	1.198		
▽	2.740		
×	3.479		REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 4.960 BETA 0.005 ELEVON - 30.000  
  RUDDER 0.000

REFERENCE INFORMATION  
REFS 0.116 SQ.FT.  
REFL 0.646 FT.  
REFB 0.405 FT.  
XHRF 0.456  
YHRF 0.000  
ZHRF 0.945

REFERENCE FILE.

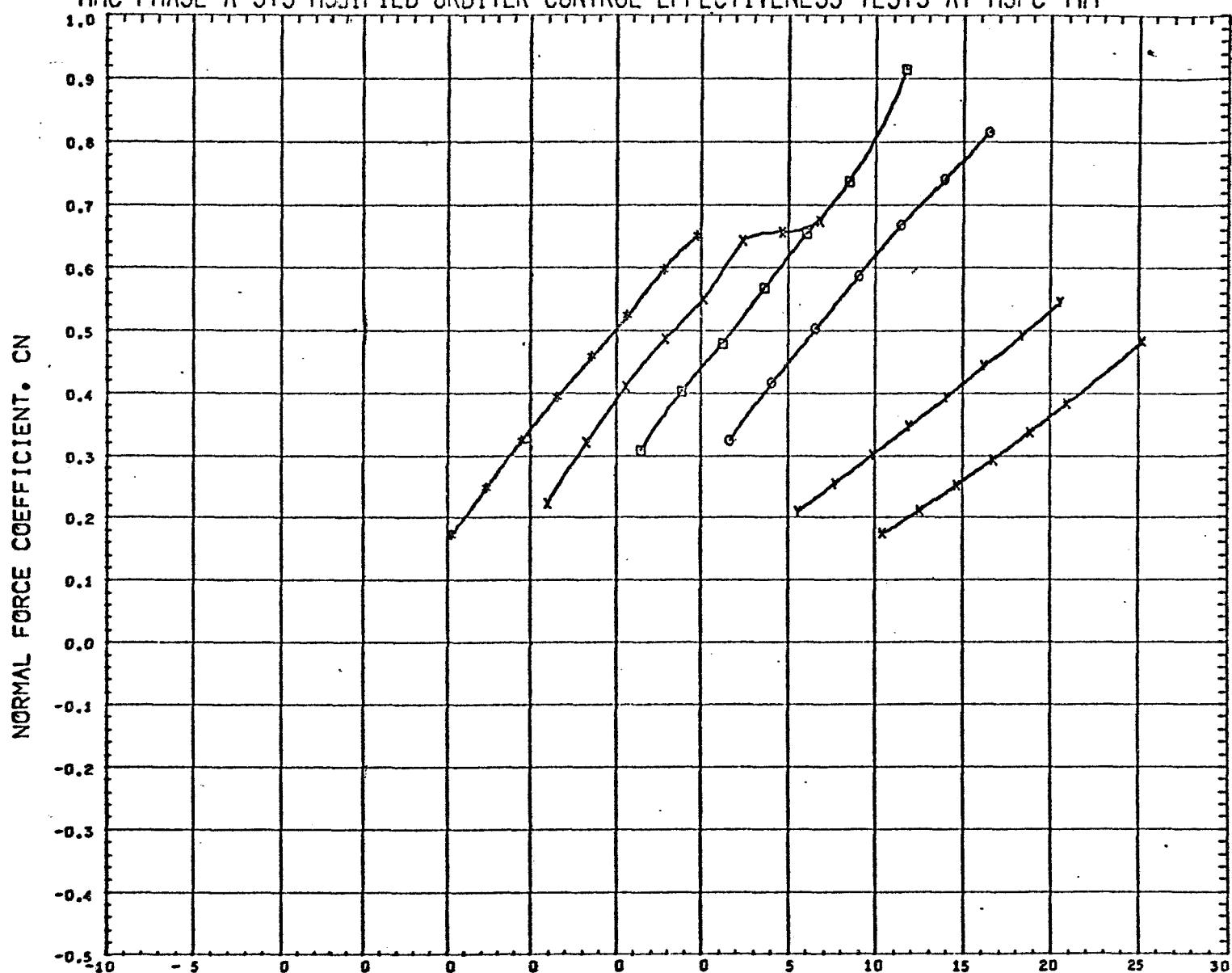
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17029) 02 JUL 70

PAGE

72

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

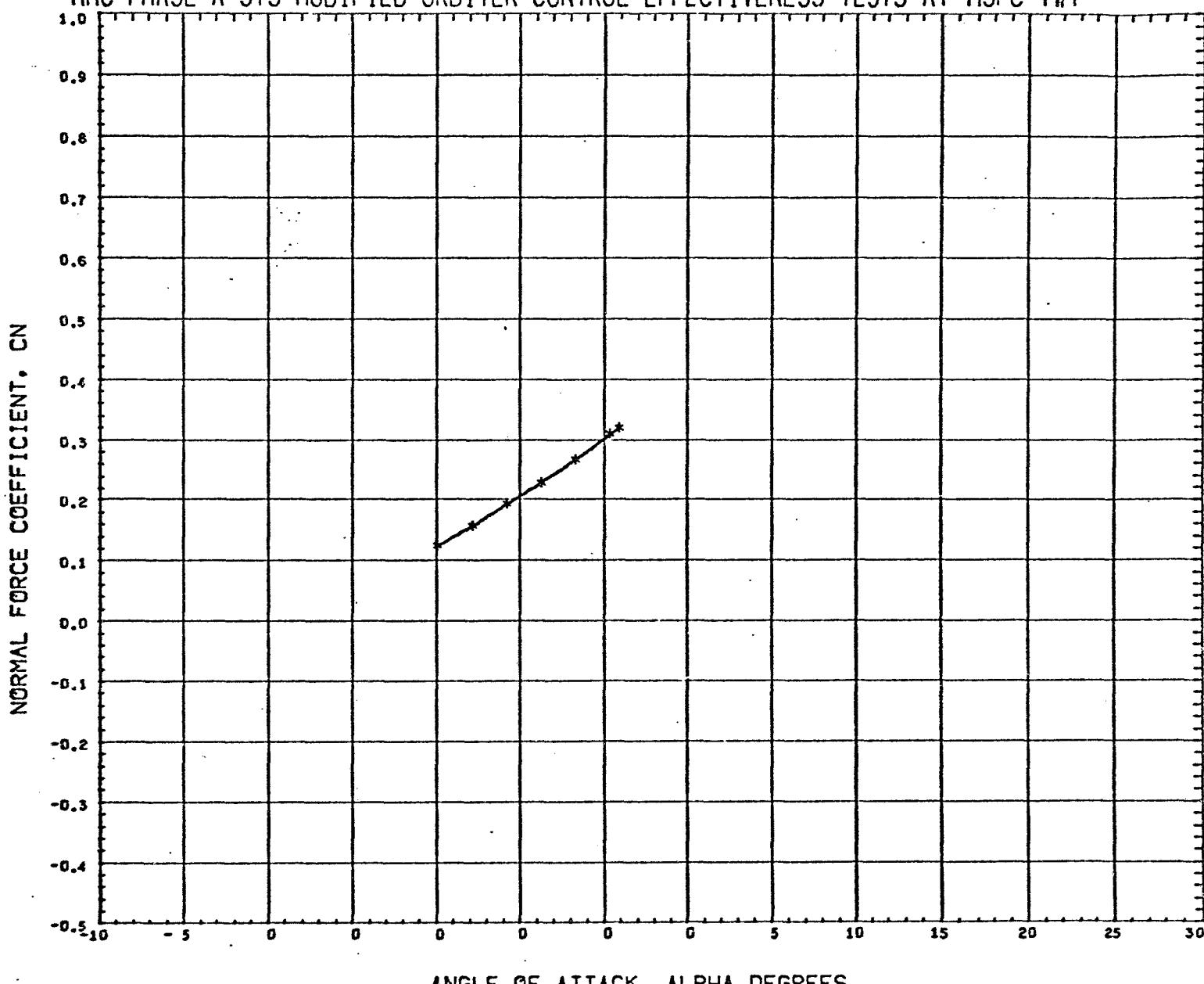


ANGLE OF ATTACK. ALPHA DEGREES

SYMBOL	MACH	PARAMETRIC VALUES	
		BETA	ELEVON - 35.000
*	0.395	0.000	
x	0.794	0.000	
s	0.995		
o	1.198		
v	2.740		
x	3.479	REFERENCE FILE.	

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 \* 4.960 BETA 0.000 ELEVON - 30.000  
 RUDDER 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.455	FT.
XHRF	0.456	
YMRF	0.500	
ZHRF	0.045	

REFERENCE FILE.

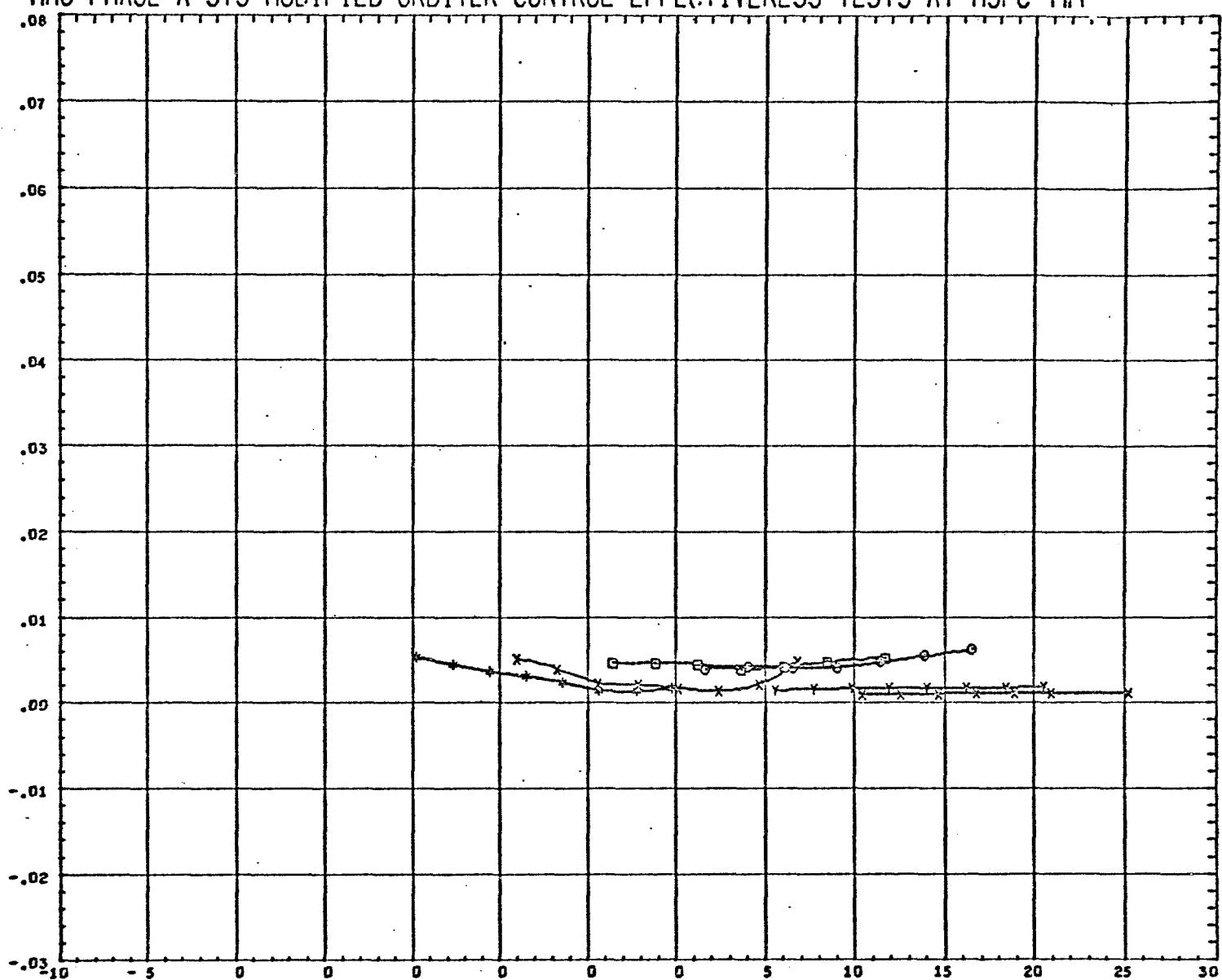
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17029) 02 JUL 70

PAGE 74

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, CABASE



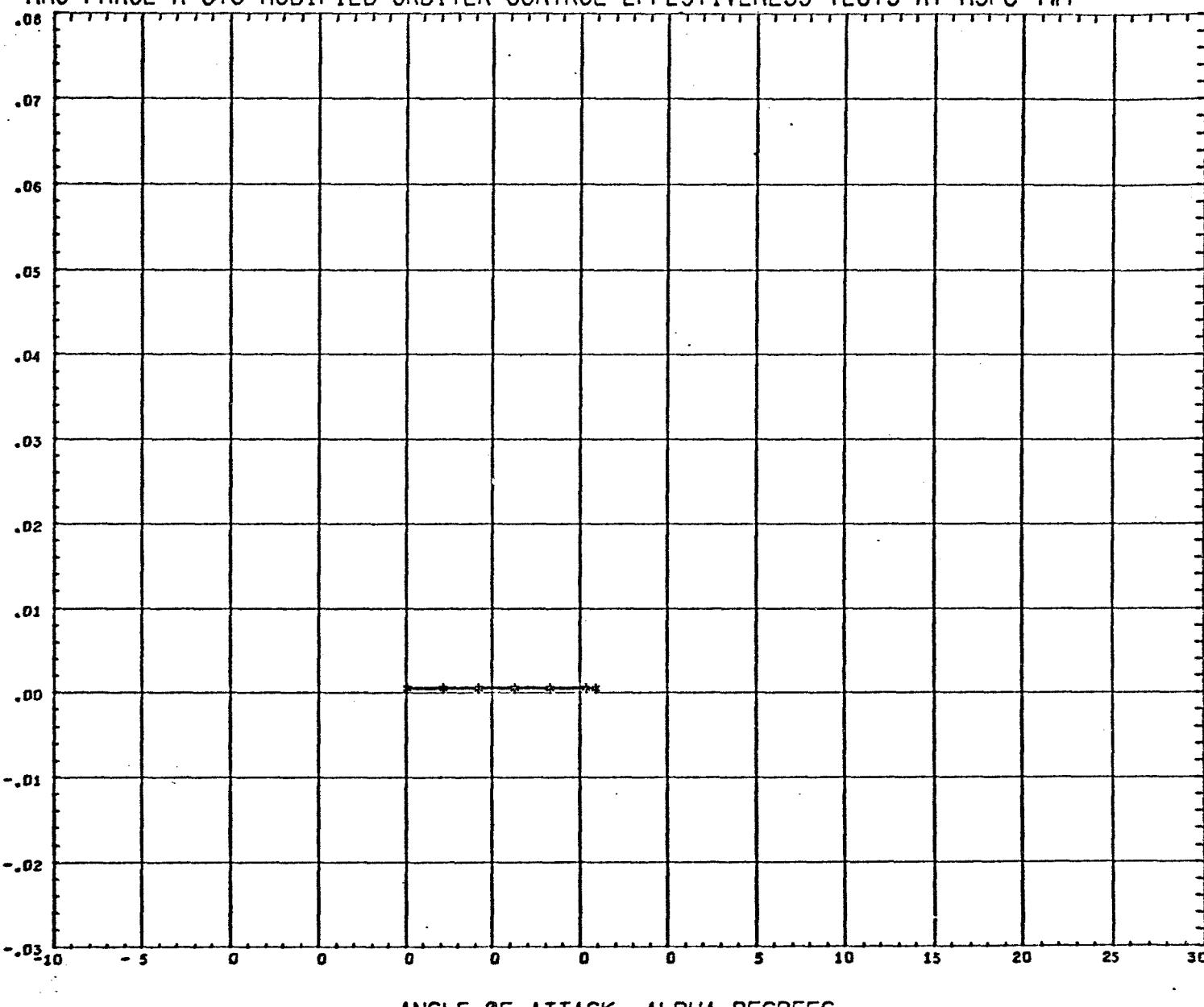
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES	ELEVON
*	0.395		0.000	- 30,000
x	0.794	RUDDER	0.000	
o	0.995			
+	1.198			
y	2.740			
x	3.479		REFERENCE FILE.	

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.486	
YMRF	0.000	
ZMRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, C<sub>A</sub>



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
\* 4.960 BETA 0.000 ELEVON - 30,000  
RUDDER 0.000

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.099	
ZHRF	0.045	

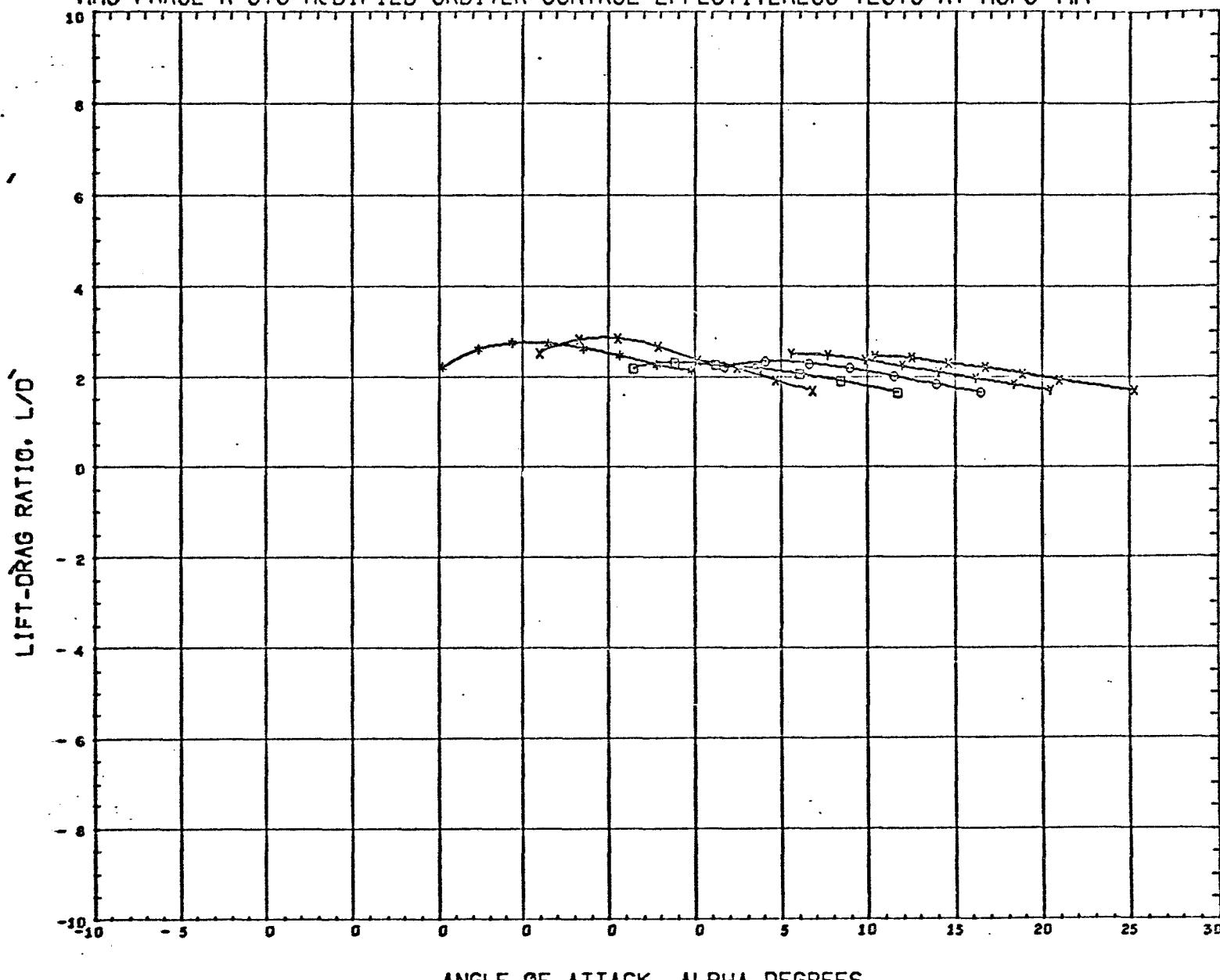
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17029) 02 JUL 70

PAGE

76

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

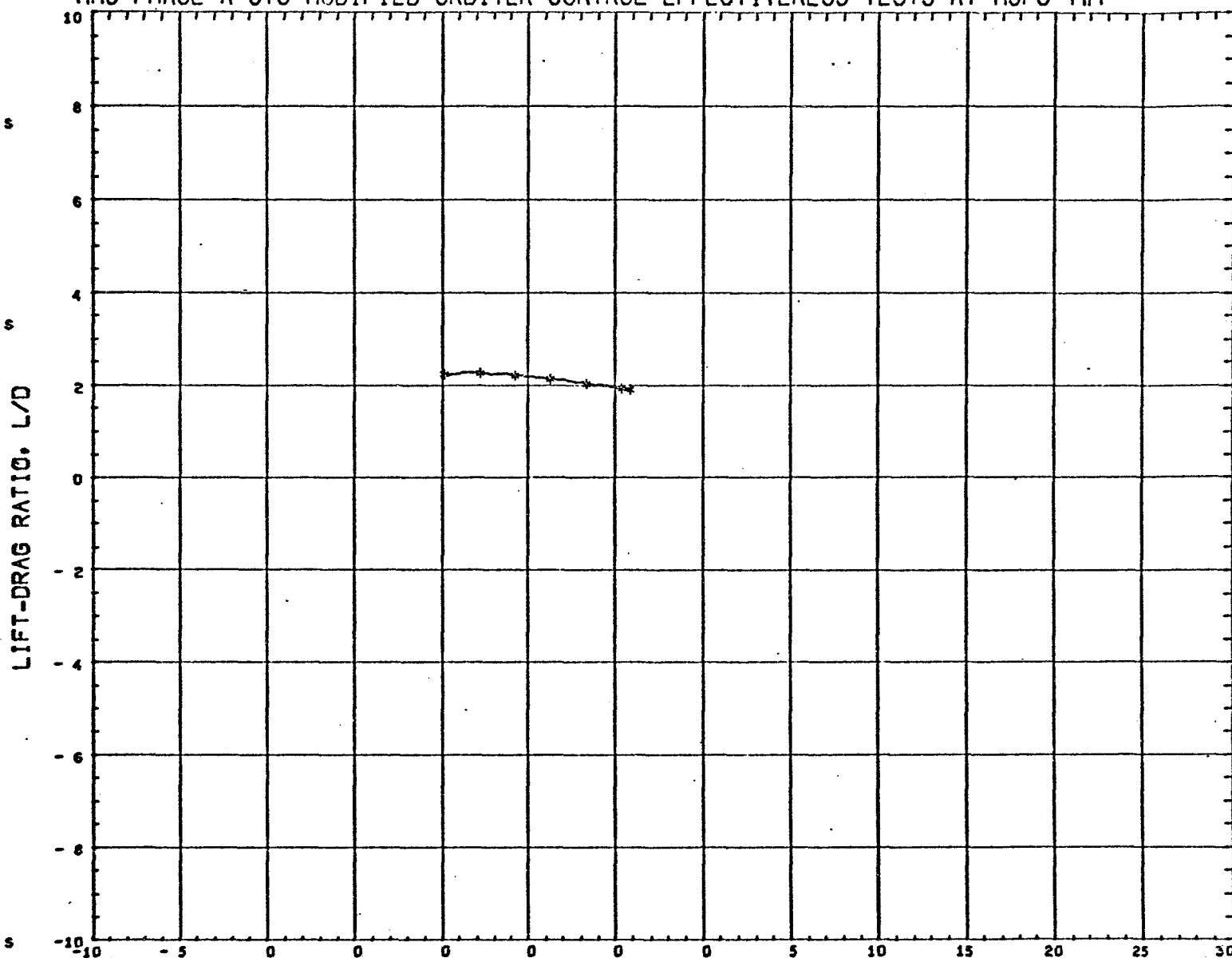


PARAMETRIC VALUES	
MACH	0.395
BETA	0.000
RUDDER	0.000
ELEVON	- 30,000

SYMBOL      MACH      PARAMETRIC VALUES  
 \*      0.395      BETA      0.000      ELEVON - 30,000  
 x      0.794      RUDDER      0.000  
 G      0.995  
 e      1.198  
 Y      2.740  
 x      3.479      REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 \* 4.960 BETA 0.000 ELEVON - 30.000  
 RUDDER 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

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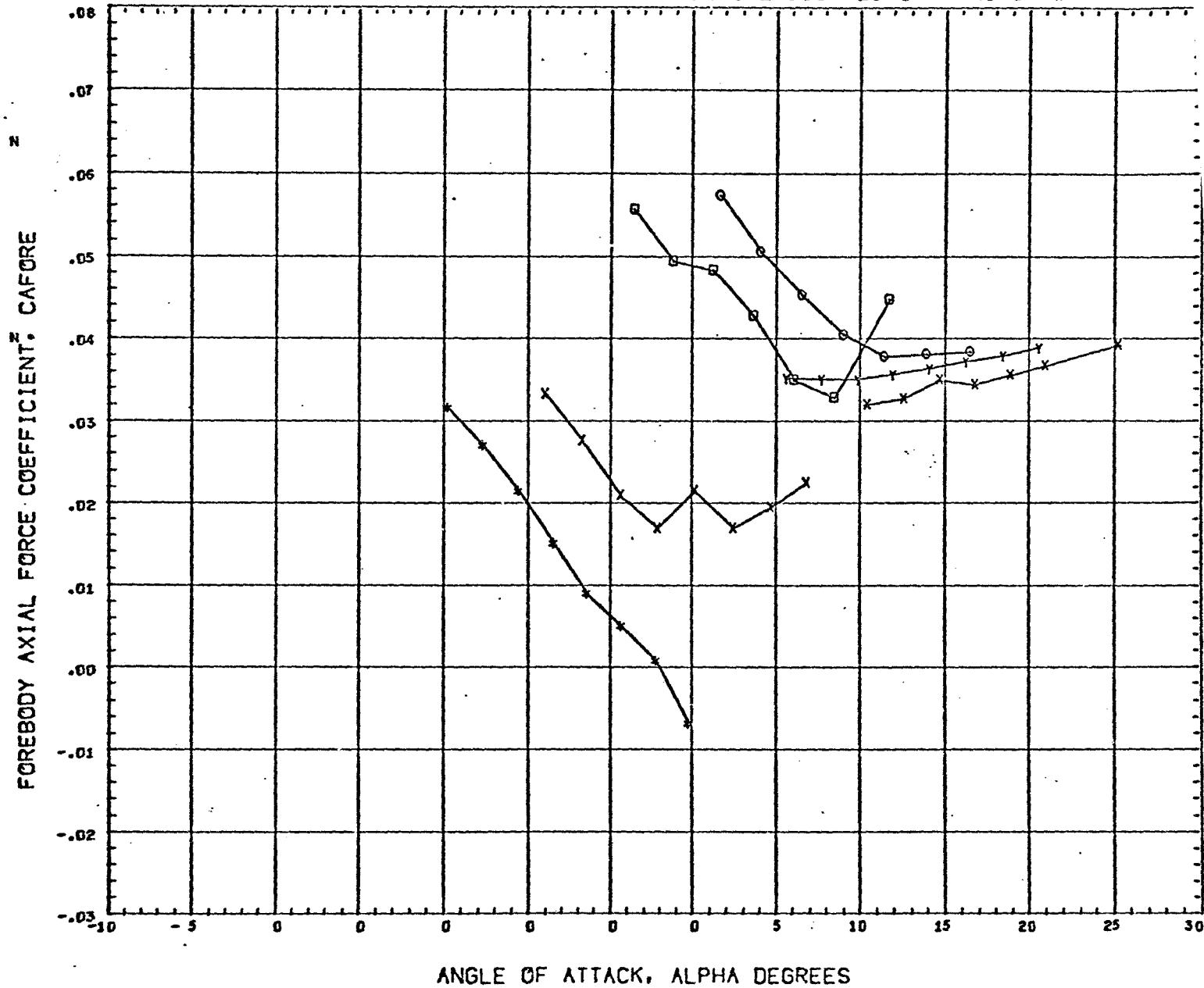
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17029) 02 JUL 70

PAGE

78

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH	PARAMETRIC VALUES		REFERENCE INFORMATION	
		BETA	ELEVON - 30.000	REFS	0.116
*	0.395	0.000		REFL	0.646
x	0.794	RUDGER	0.000	REFB	0.405
o	0.995			XHRF	0.406
o	1.198			YHRF	0.000
y	2.740			ZHRF	0.945
x	3.479	REFERENCE FILE.			

\*MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

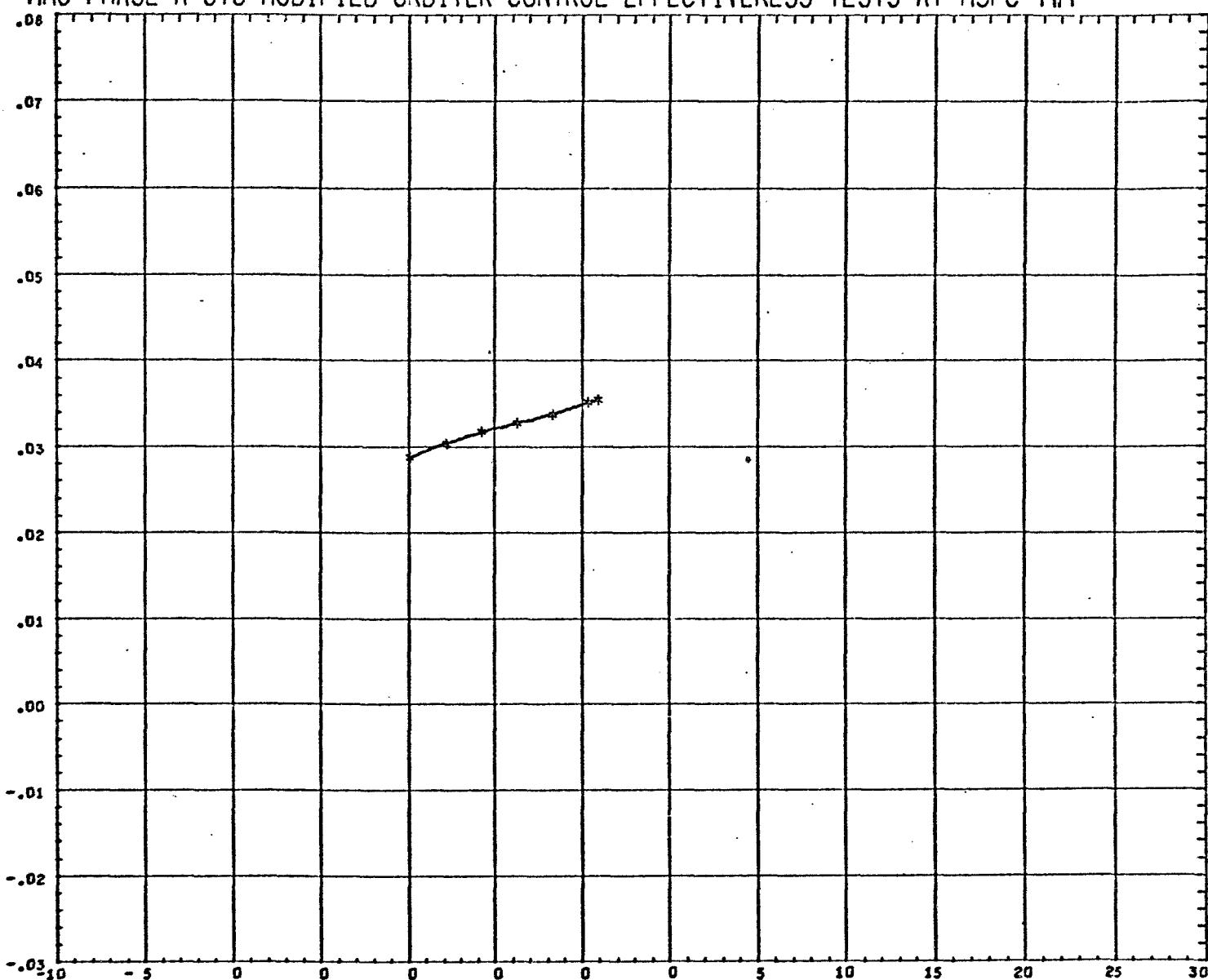
(R17029) 06 JUL 70

PAGE

79

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAFOR



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
T \* 4.960 BETA 0.000 ELEVON - 35.000  
RUDDER 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

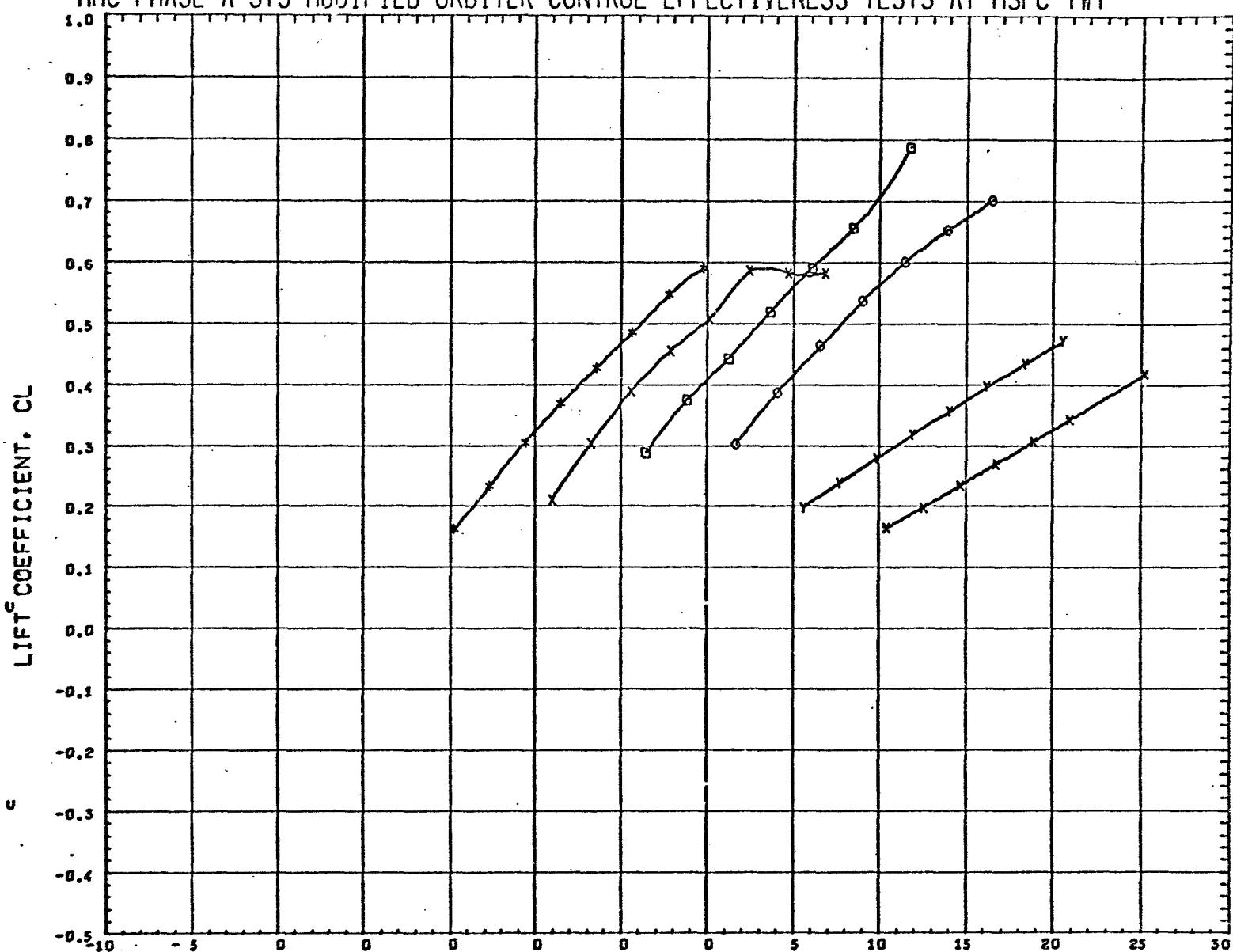
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17029) 02 JUL 70

PAGE

80

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



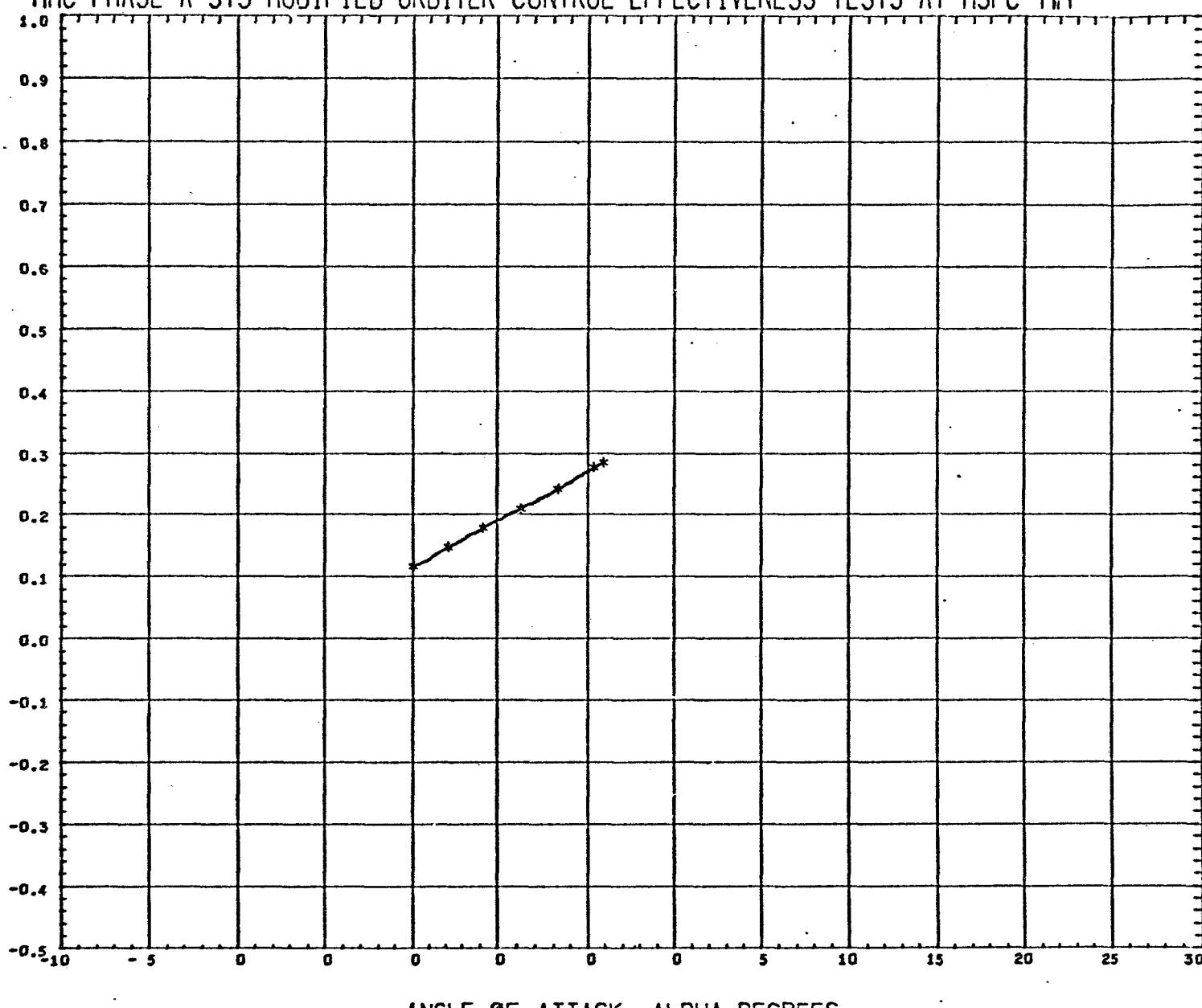
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.395	0.000	ELEVON - 30.000
x	0.794	0.000	RUDDER
o	0.995		
o	1.198		
y	2.740		
x	3.479		REFERENCE FILE.

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.406
YHRF 0.000
ZHRF 0.045

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

LIFT COEFFICIENT. CL



ANGLE OF ATTACK. ALPHA DEGREES

SYMBOL MACH PARAMETRIC VALUES  
 • 4.969 BETA 0.000 ELEVON - 30.000  
 RUDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.406  
 YHRF 0.000  
 ZHRF 0.045

REFERENCE FILE.

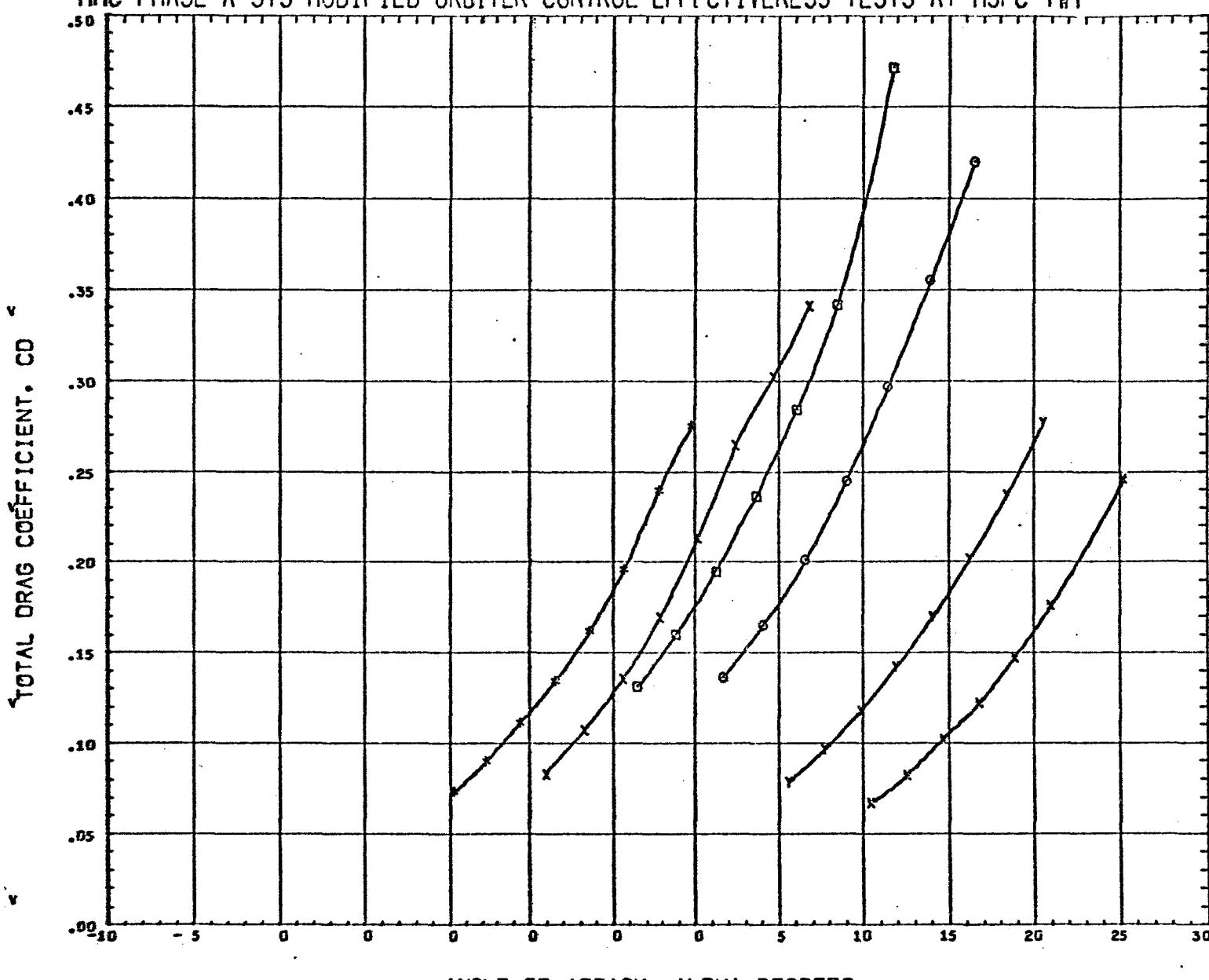
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(S17029) 02 JUL 70

PAGE

82

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

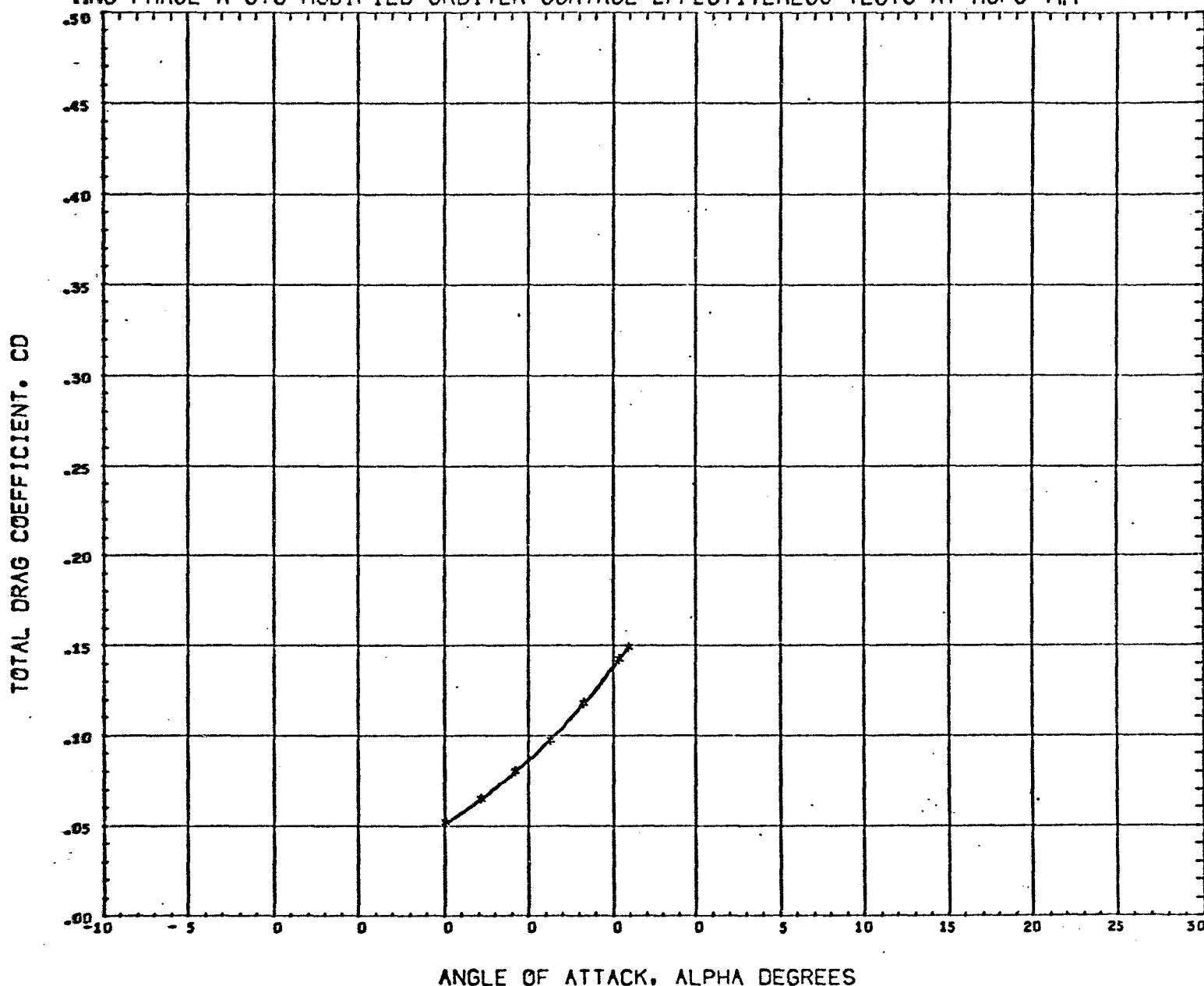


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	MACH	PARAMETRIC VALUES		
*	0.395	BETA	0.000	ELEVON - 35.500
x	0.794	RUDDER	0.000	
o	0.995			
e	1.198			
y	2.740			
x	3.479			REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.060	
ZHRF	0.045	

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH	PARAMETRIC VALUES		
*	4.969	BETA	0.000	ELEVON - 30.000
		RUDDER	0.000	

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.396	
ZHRF	0.345	

**REFERENCE FILE.**

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

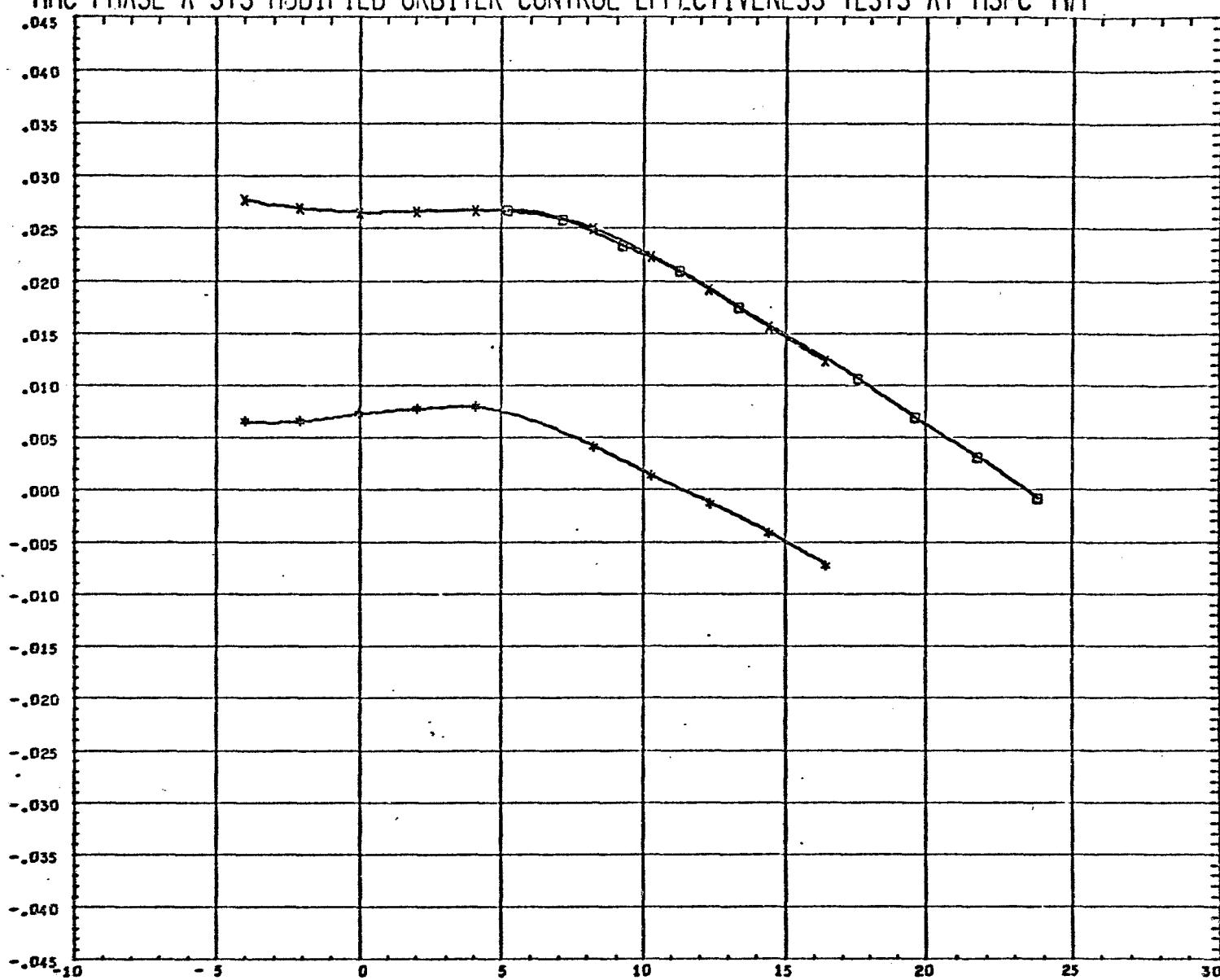
(S17029) 02 JUL 70

PAGE

84

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MMC MOD ORB B2W2E1 DEL E0
x	MSFC 453 MMC MOD ORB B2W2E1 E=-15
o	MSFC 453 MMC MOD ORB B2W2E1 E=-15

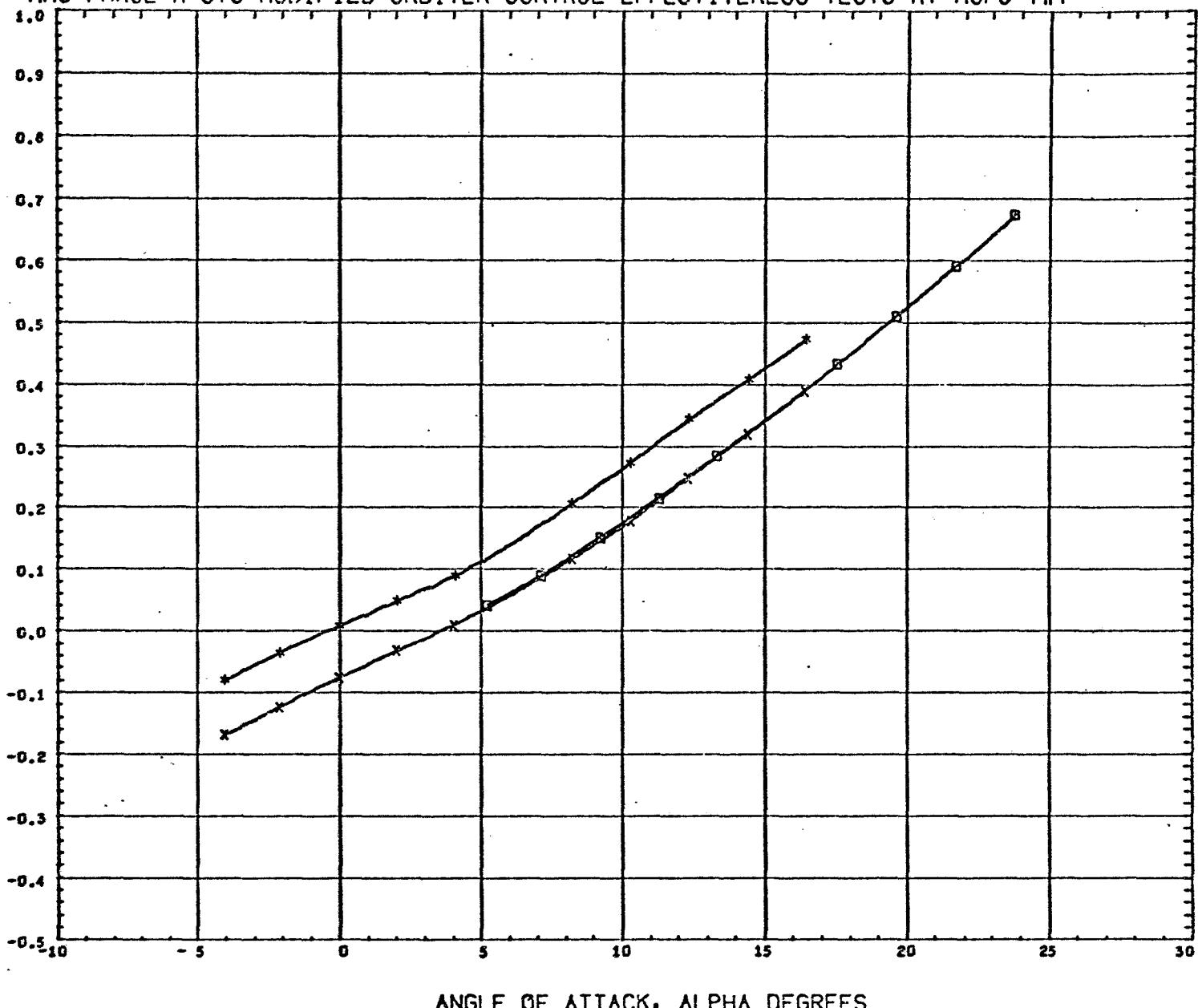
DATA SET	DATE	MACH NUMBER
(B17021)	02 JUL 70	0.395
(B17022)	02 JUL 70	
(B17023)	02 JUL 70	

REFERENCE	INFORMATION
REFS	0.116 SQ.FT.
REFL	0.646 FT.
REFB	0.405 FT.
XHRF	0.406
YHRF	0.000
ZHRF	0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

NORMAL FORCE COEFFICIENT, CN



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL      CONFIGURATION DESCRIPTION

\*    MSFC 453 MMC M00 ORB E2W2E1 DEL EO  
 x    MSFC 453 MMC M00 ORB E2W2E1    E=-15  
 □    MSFC 453 MMC M00 ORB E2W2E1    E=-15

DATA SET      DATE      MACH NUMBER

(B17521)    02 JUL 70    0.395  
 (B17522)    02 JUL 70  
 (B17523)    02 JUL 70

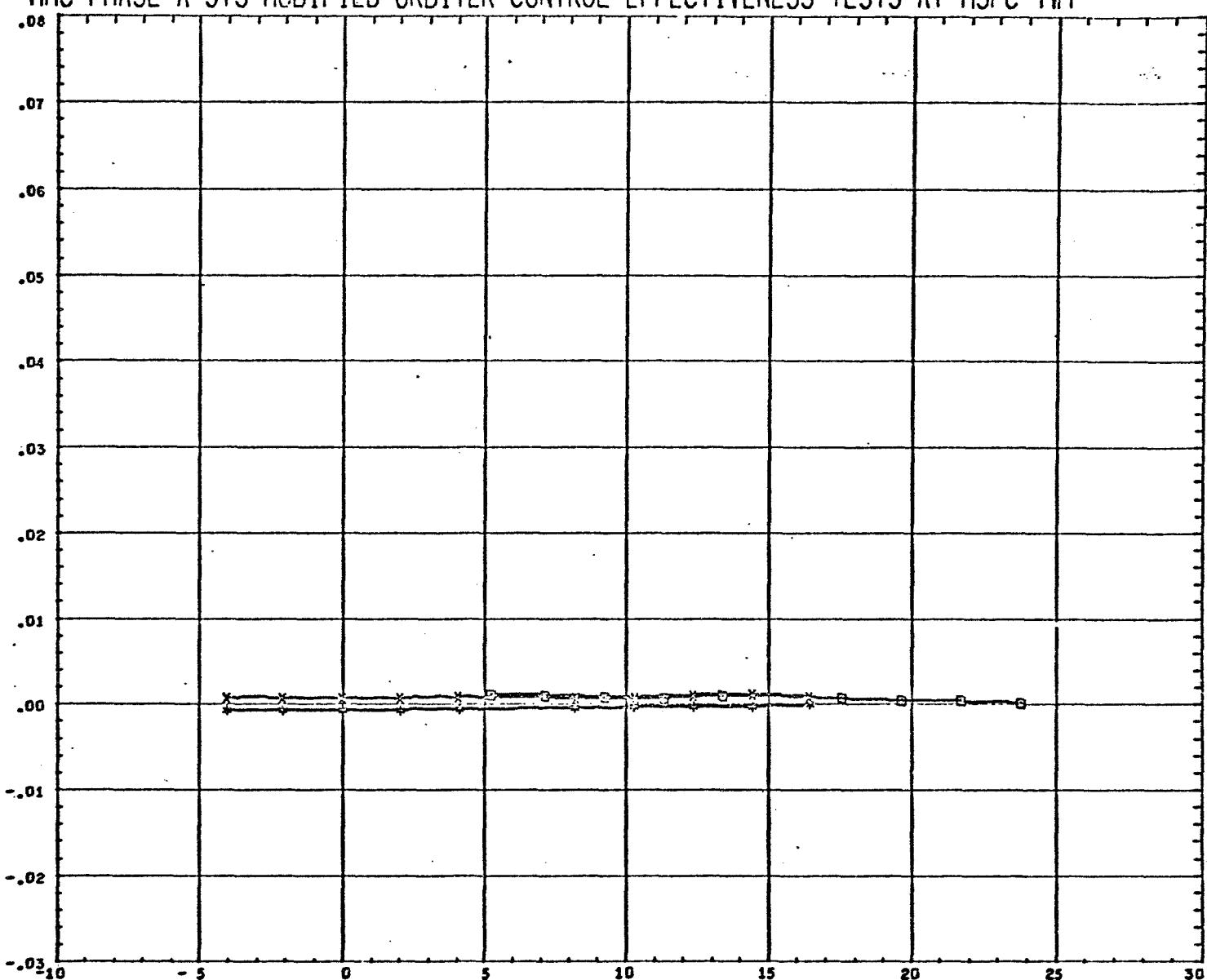
REFERENCE INFORMATION

REFS    0.116    SQ.FT.  
 REFL    0.646    FT.  
 REFB    0.405    FT.  
 XMRP    0.406  
 YMRP    0.000  
 ZMRP    0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, CABASE



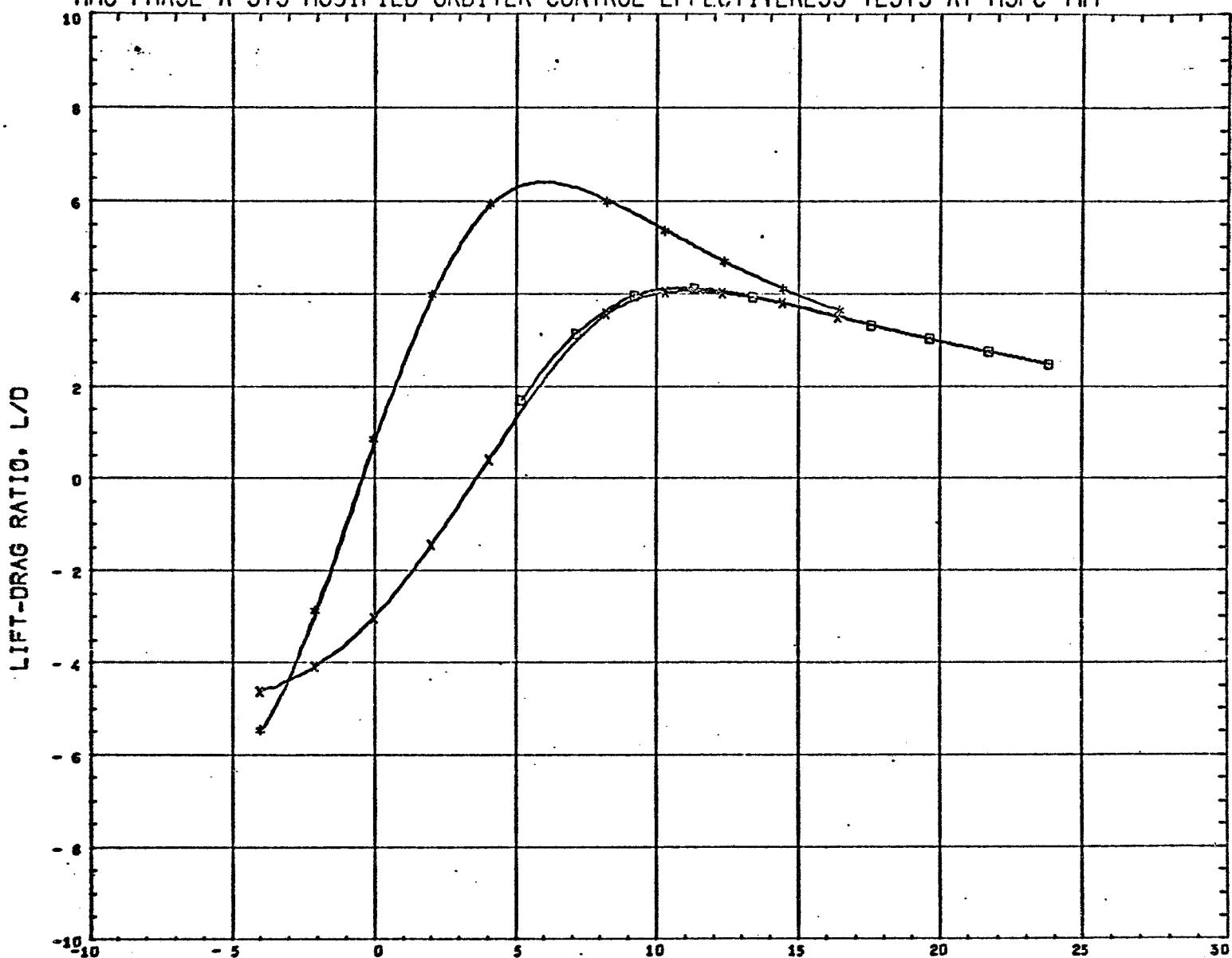
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MHC HOC ORB B2W2E1 DEL E0
X	MSFC 453 MHC HOC ORB B2W2E1 E=-15
G	MSFC 453 MHC HOC ORB B2W2E1 E=-15

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(B17021)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
(B17022)	02 JUL 70		REFL 0.646 FT.
(B17023)	02 JUL 70		REFB 0.405 FT.
			XHRF 0.406
			YHRF 0.500
			ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



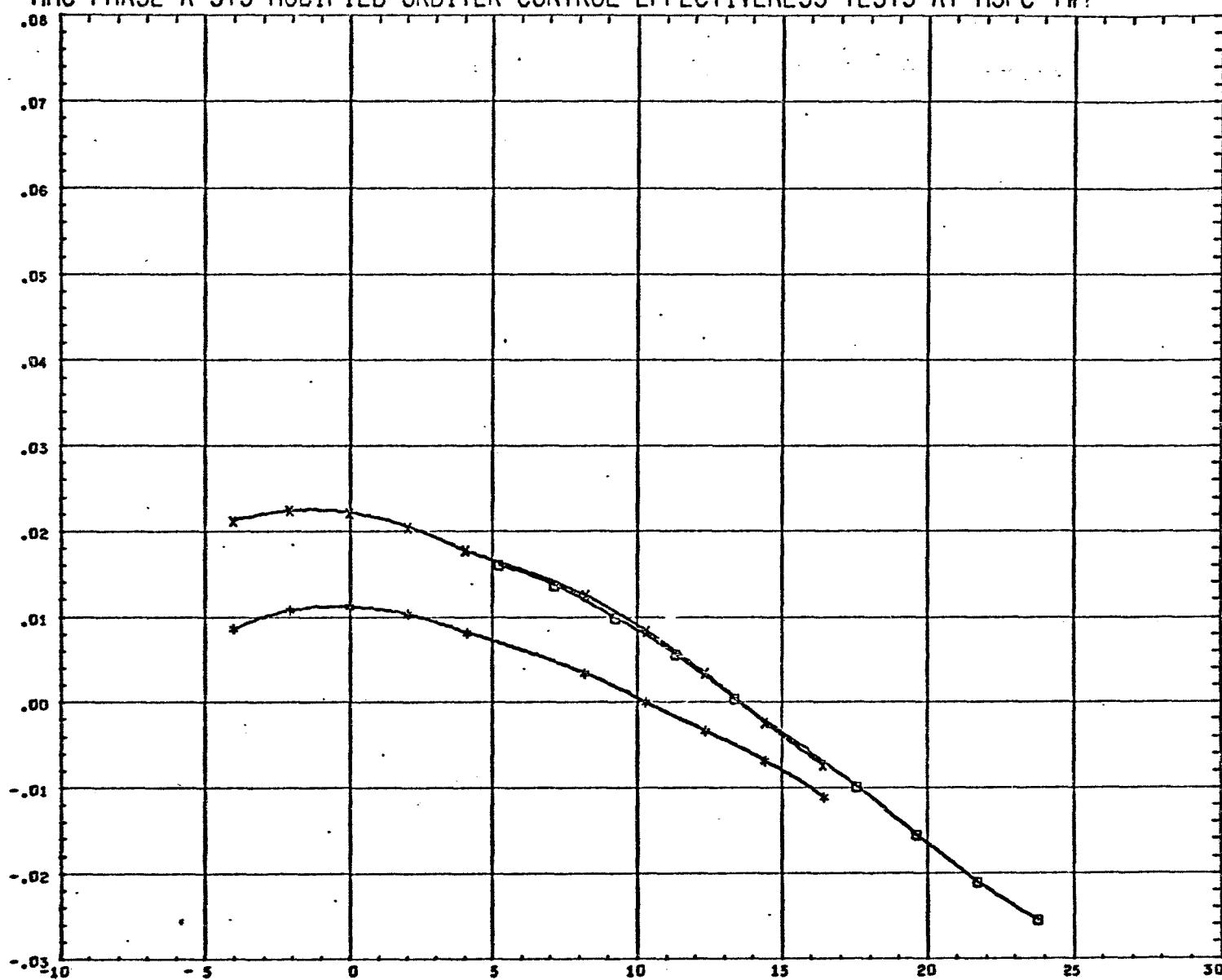
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2E1 DEL E0	(R17021)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOD ORB B2W2E1 E=-15	(B17022)	02 JUL 70	0.395	REFL 0.646 FT.
o	MSFC 453 MMC MOD ORB B2W2E1 E=-15	(B17023)	02 JUL 70	0.395	REFS 0.405 FT. XHRF 0.406 YHRF 0.000 ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAFOR

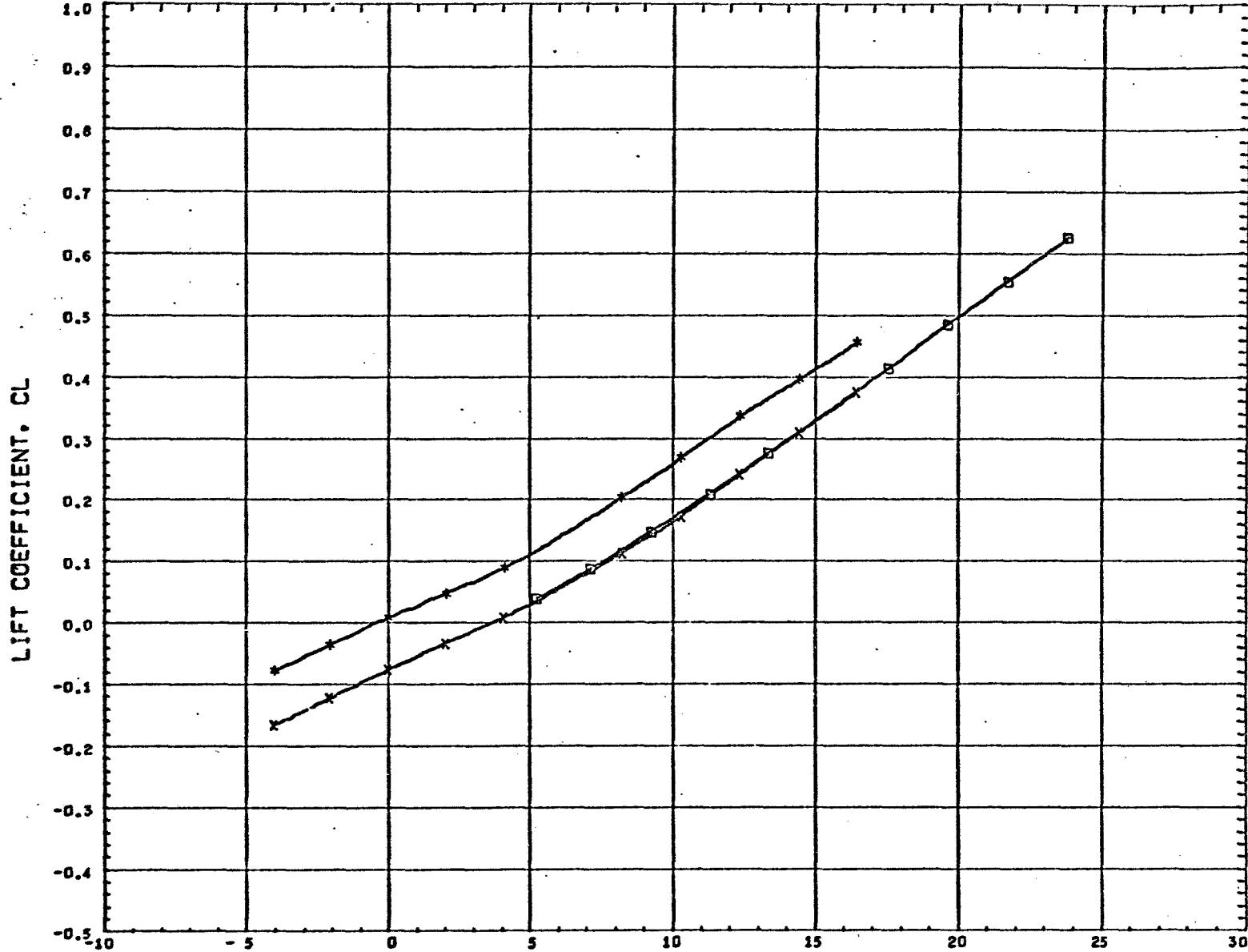


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2E1 DEL EQ	(R17021)	02 JUL 79	0.395	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOD ORB B2W2E1 E=15	(B17022)	02 JUL 79		REFL 0.646 FT.
o	MSFC 453 MMC MOD ORB B2W2E1 E=-15	(B17023)	02 JUL 79		REFB 0.405 FT. XHRF 0.406 THRF 0.000 ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION

\* MSFC 453 MHC MOD ORB E2W2E1 DEL EO  
 X MSFC 453 MHC MOD ORB E2W2E1 E=15  
 S MSFC 453 MHC MOD ORB 32W2E1 E=15

DATA SET DATE MACH NUMBER

(S17G21) 02 JUL 70 0.395  
 (T17G22) 02 JUL 70  
 (T17G23) 02 JUL 70

REFERENCE INFORMATION

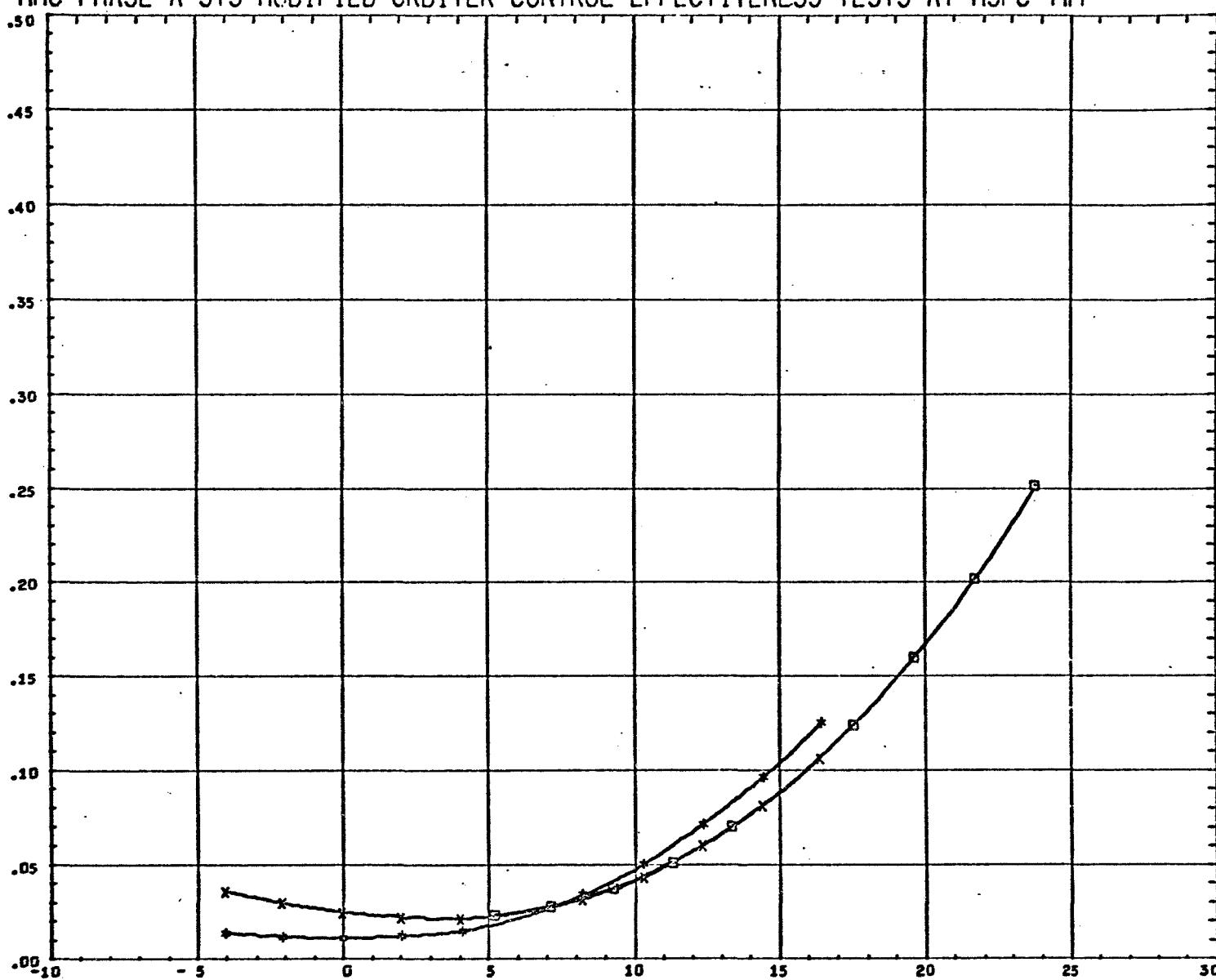
REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.456  
 YHRF 0.000  
 ZHRF 0.045

REFERENCE FILE.

PAGE 90

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT, CD



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION

\* MSFC 453 MMC MOD ORB B2W2E1 DEL EG  
 X MSFC 453 MMC MOD ORB E2W2E1 E=-15  
 G MSFC 453 MMC MOD ORB B2W2E1 E=-15

DATA SET DATE MACH NUMBER

(S17021) 02 JUL 70 0.395  
 (T17022) 02 JUL 70  
 (T17023) 02 JUL 70

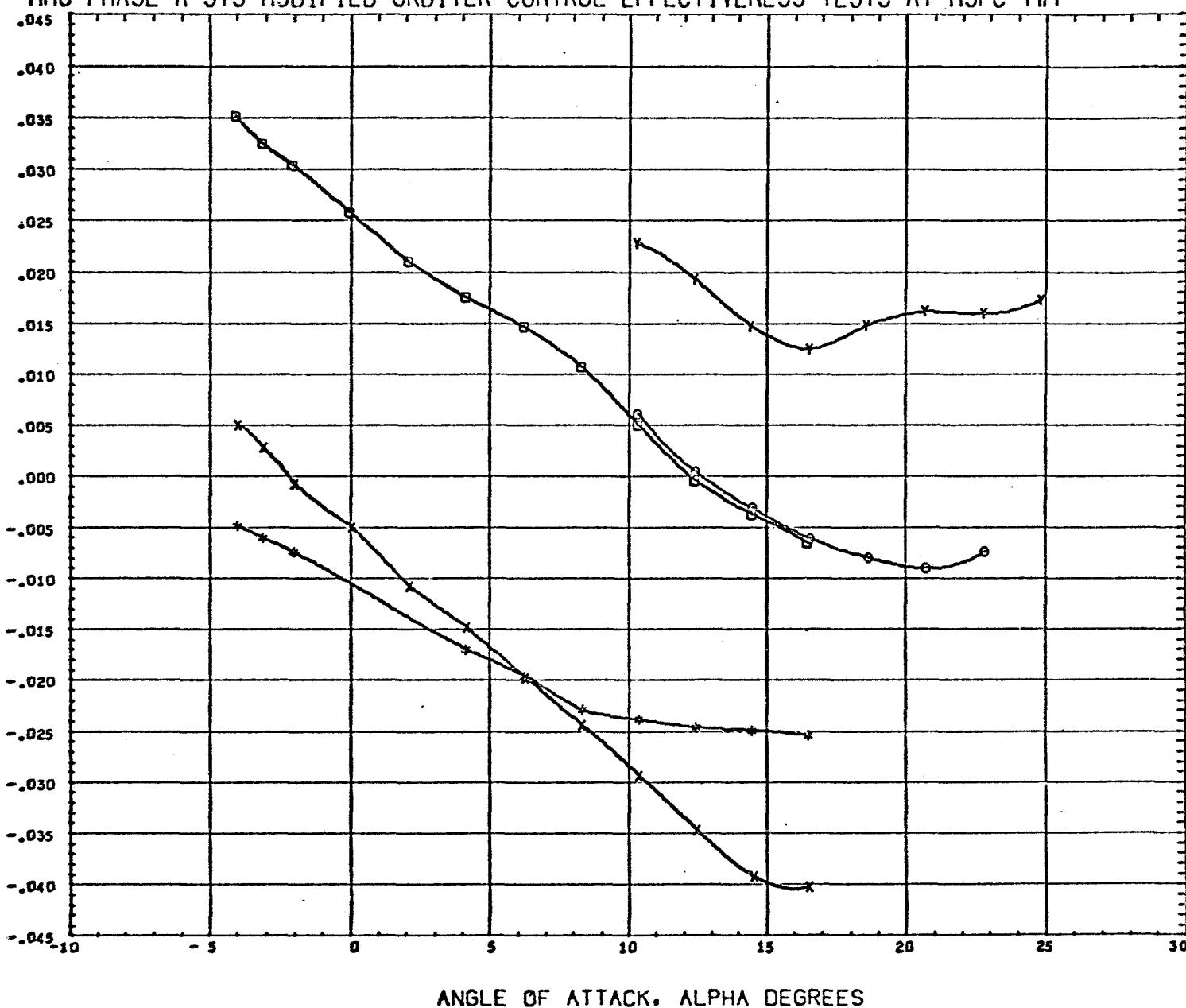
REFERENCE INFORMATION

REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XMRF 0.406  
 YMRF 0.000  
 ZMRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT. CNM



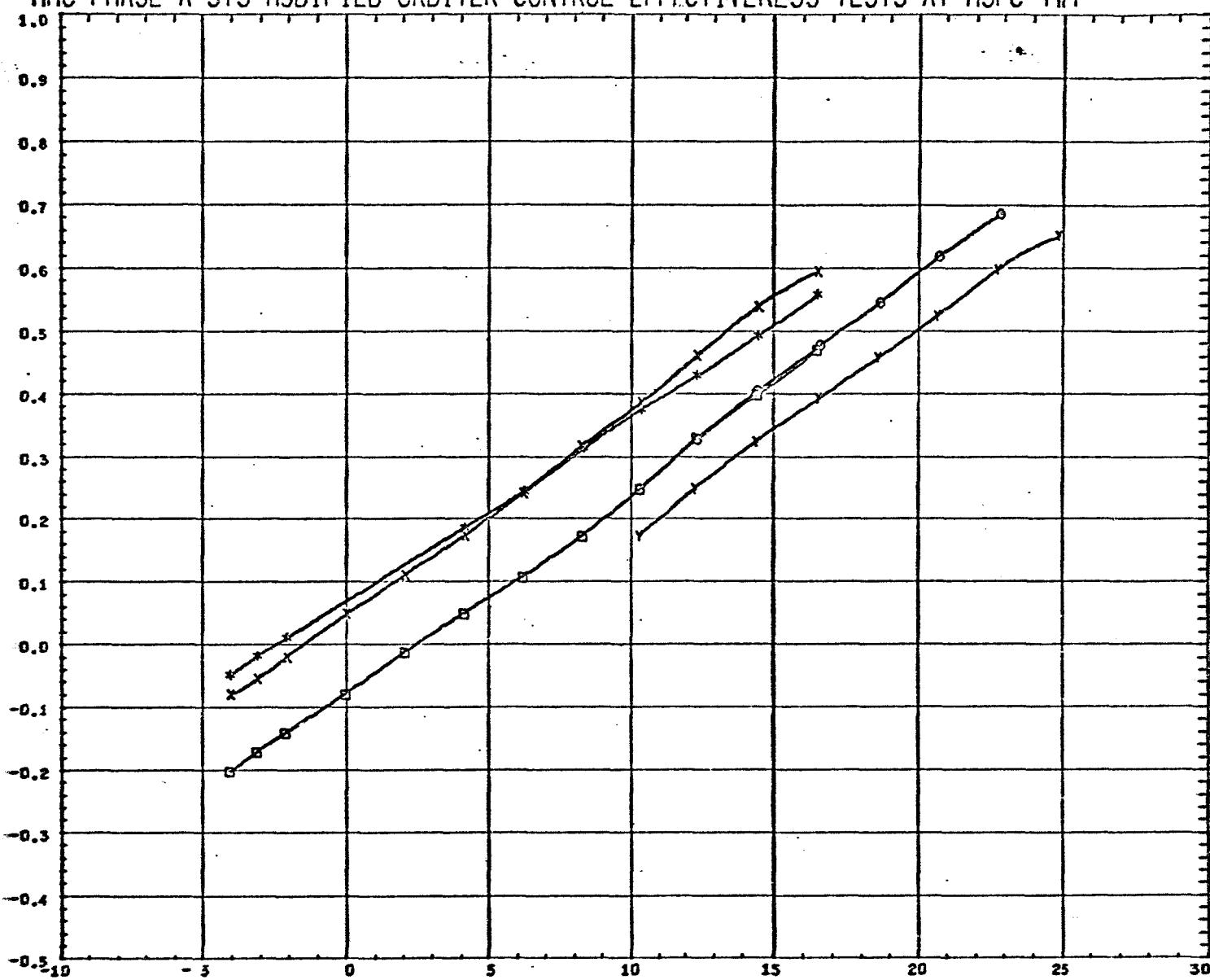
ANGLE OF ATTACK. ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(B17024)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(B17025)	02 JUL 70		REFL 0.646 FT.
o	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(B17026)	02 JUL 70		REFB 0.405 FT.
*	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(B17028)	02 JUL 70		XHRF 0.406
y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(B17029)	02 JUL 70		ZHRF 0.550
					ZNRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

NORMAL FORCE COEFFICIENT, CN



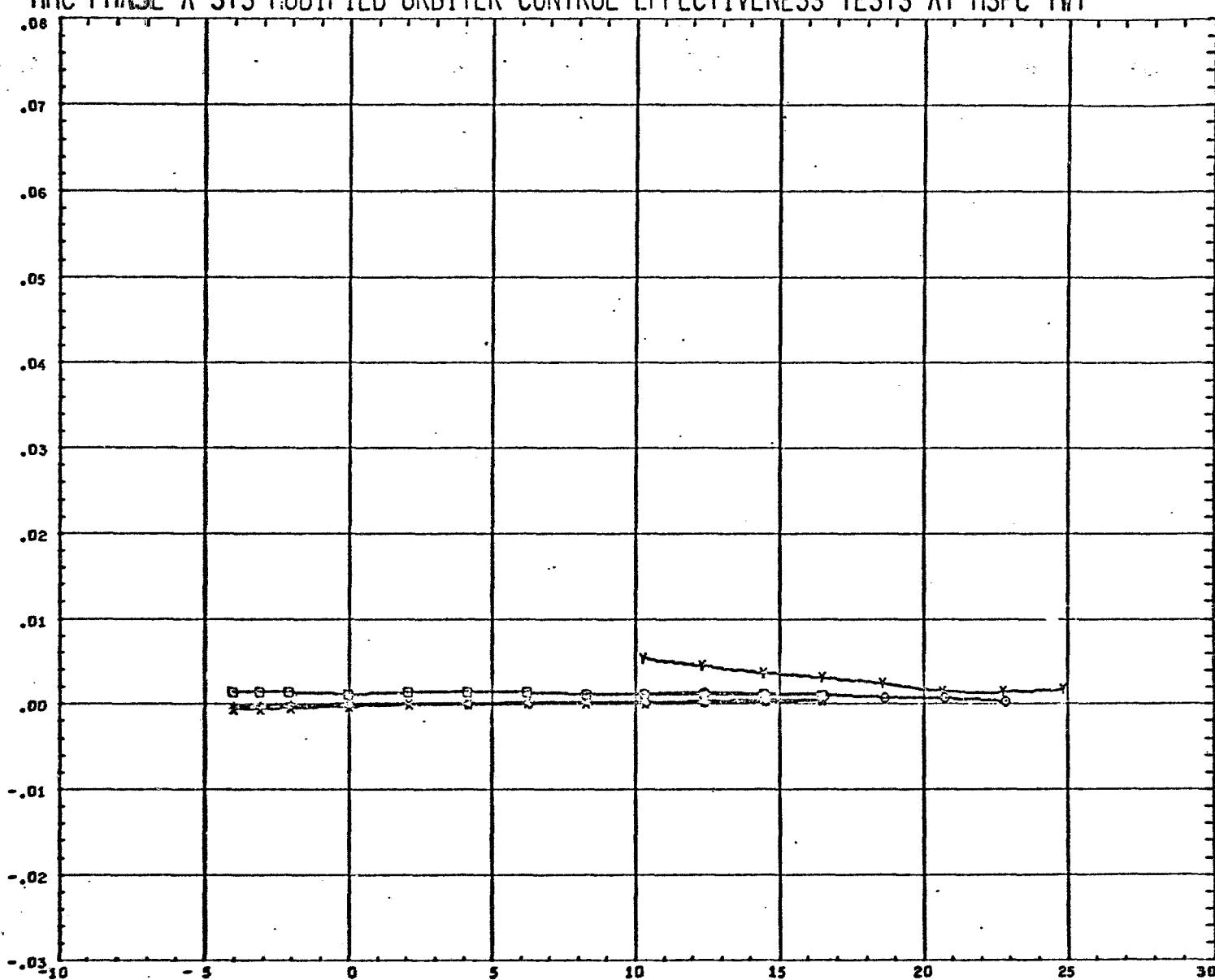
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MHC MOD ORB B2W2T1R1 E=OFF	(B17524)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
X	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=0	(B17525)	02 JUL 70	0.395	REFL 0.646 FT.
G	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-15	(B17526)	02 JUL 70	0.395	REFB 0.405 FT.
G	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-15	(B17528)	02 JUL 70	0.395	XMRF 0.406
Y	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-30	(B17529)	02 JUL 70	0.395	ZMRF 0.000

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, CABASE

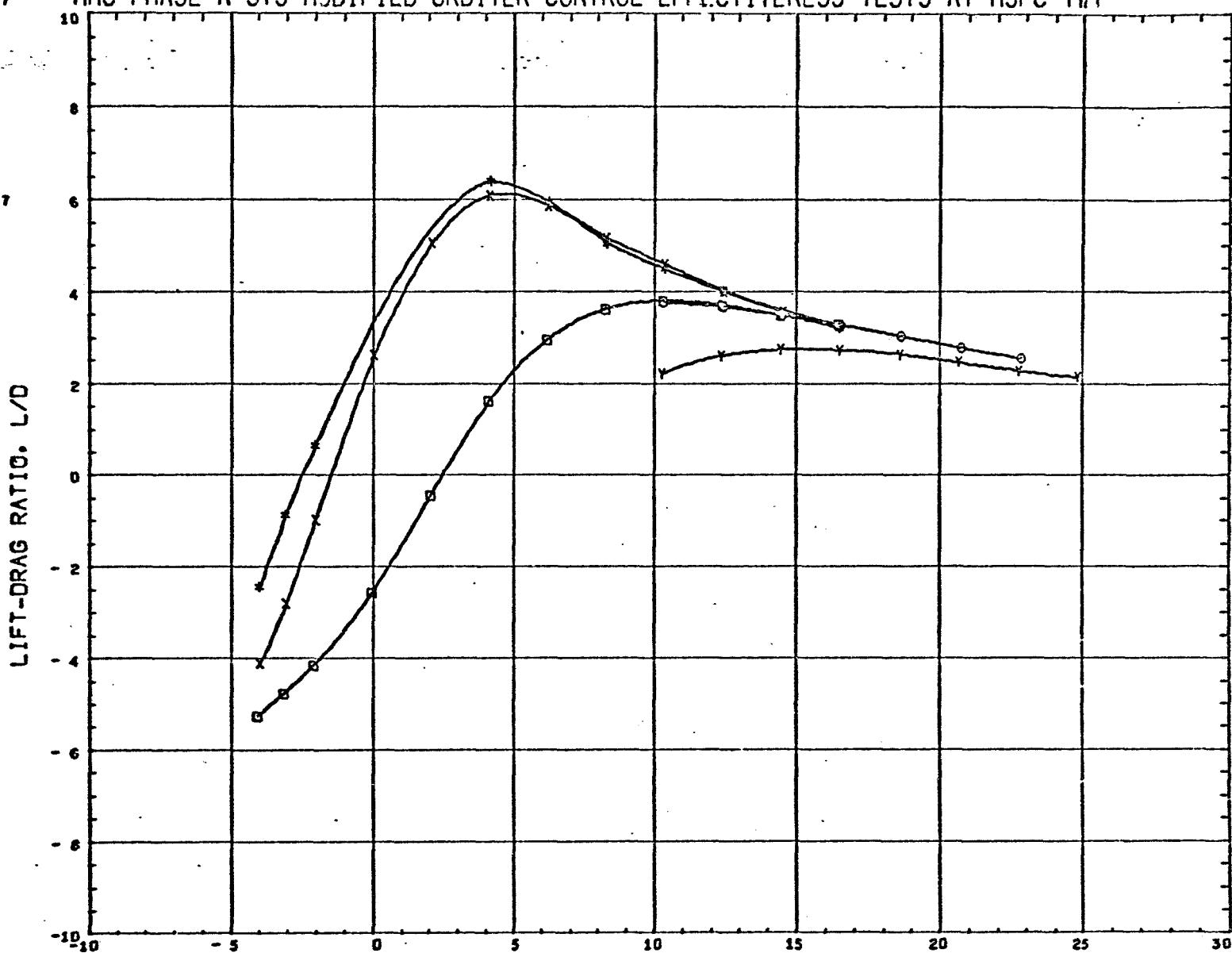


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(B17024)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(B17025)	02 JUL 70		REFL 0.646 FT.
o	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(B17026)	02 JUL 70		REFB 0.495 FT.
+	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(B17028)	02 JUL 70		XMRP 0.406
y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(B17029)	02 JUL 70		ZMRP 0.000

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



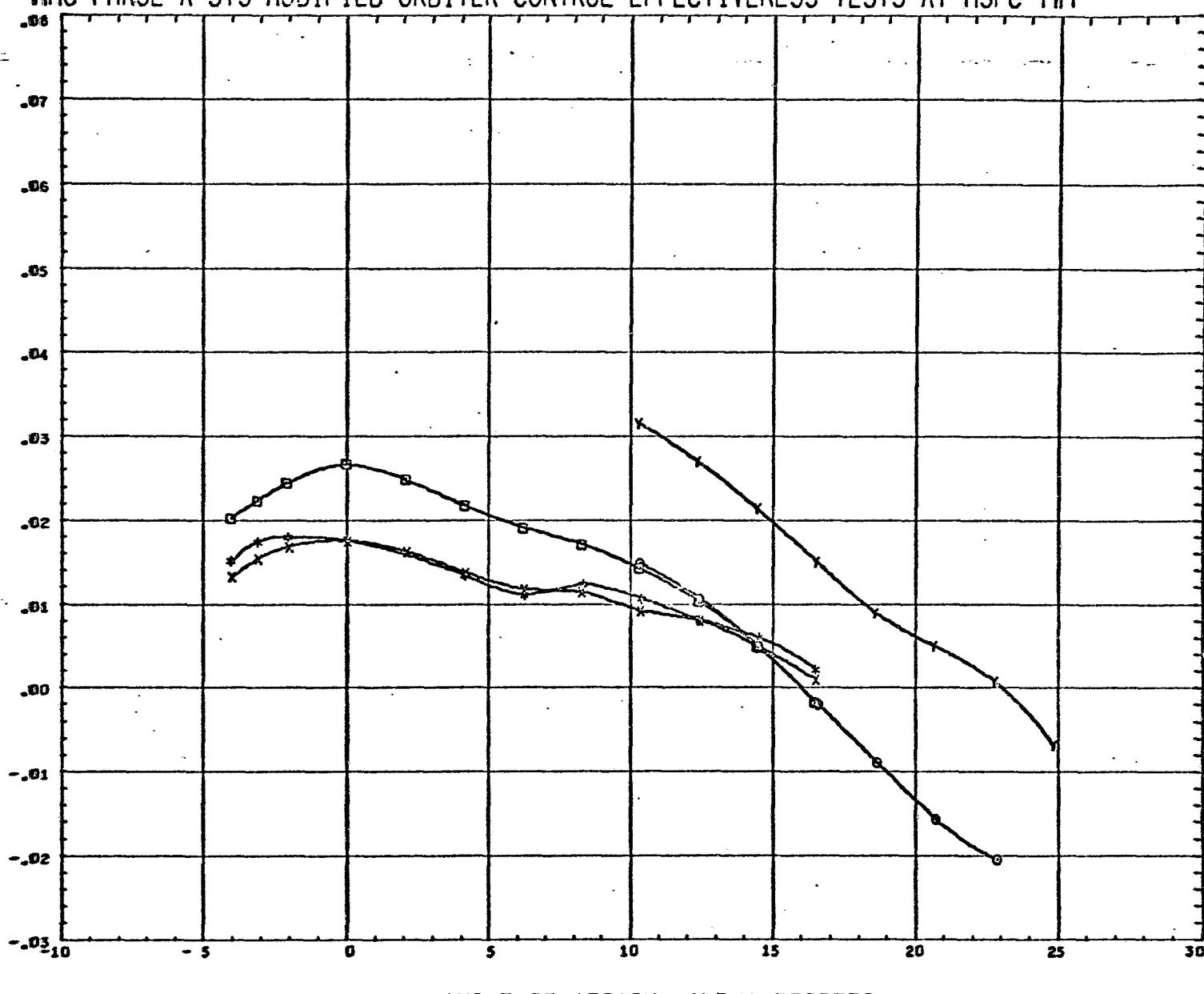
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
●	MSFC 453 MMC MOC ORB B2W2T1R1 E=OFF	(B17024)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOC ORB B2W2T1E1R1 E=0	(B17025)	02 JUL 70		REFL 0.646 FT.
○	MSFC 453 MMC MOC ORB B2W2T1E1R1 E=-15	(B17026)	02 JUL 70		REFB 0.405 FT.
○	MSFC 453 MMC MOC ORB B2W2T1E1R1 E=-15	(B17028)	02 JUL 70		XHRF 0.456
★	MSFC 453 MMC MOC ORB B2W2T1E1R1 E=-30	(B17029)	02 JUL 70		YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAF<sub>0</sub>

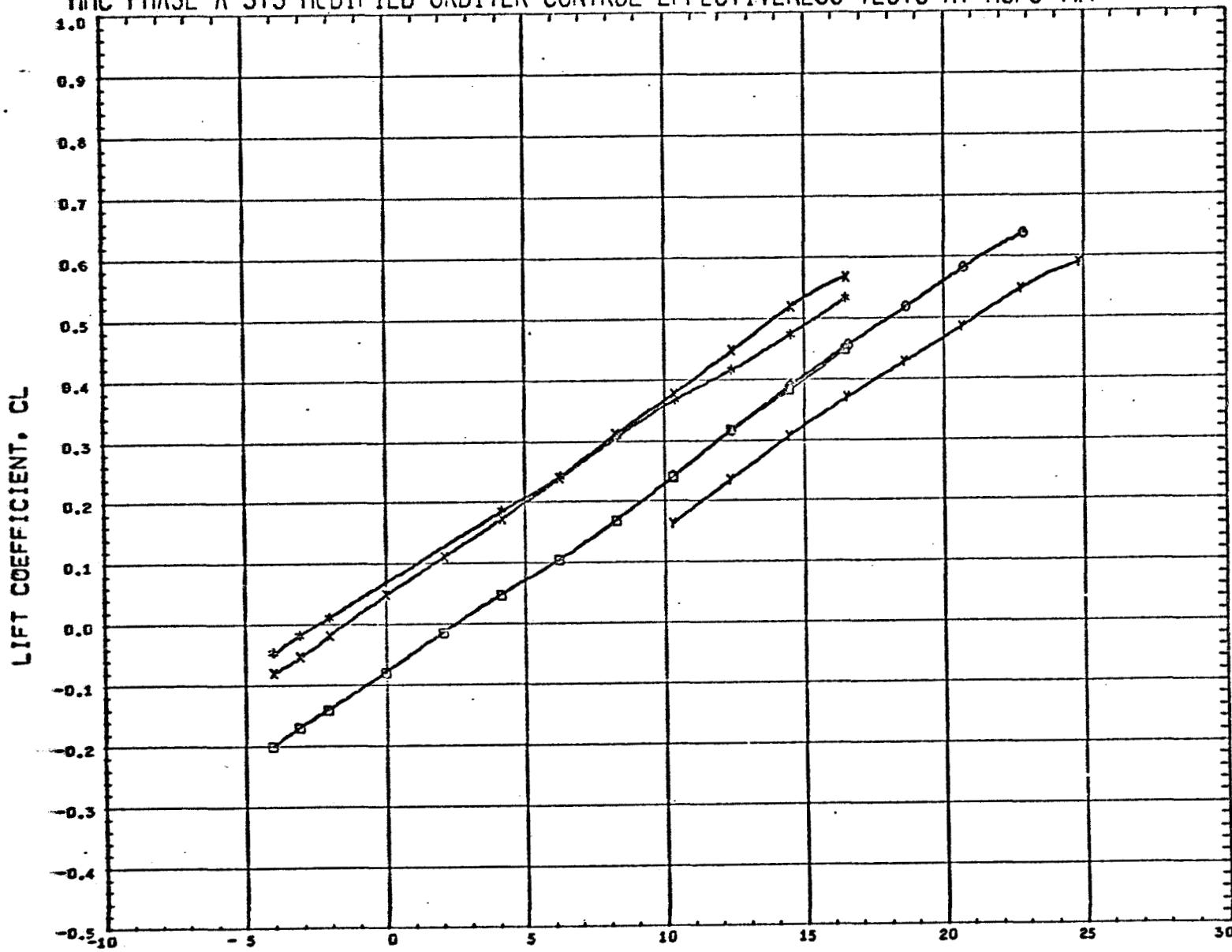


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB 52W2T1R1 E=OFF	(B17024)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB 52W2T1E1R1 E=0	(B17025)	02 JUL 70	0.395	REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB 52W2T1E1R1 E=-15	(B17026)	02 JUL 70	0.395	REFB 0.405 FT.
G	MSFC 453 MMC MOD ORB 52W2T1E1R1 E=-15	(B17028)	02 JUL 70	0.395	XHRF 0.406
T	MSFC 453 MMC MOD ORB 52W2T1E1R1 E=-30	(B17029)	02 JUL 70	0.395	YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



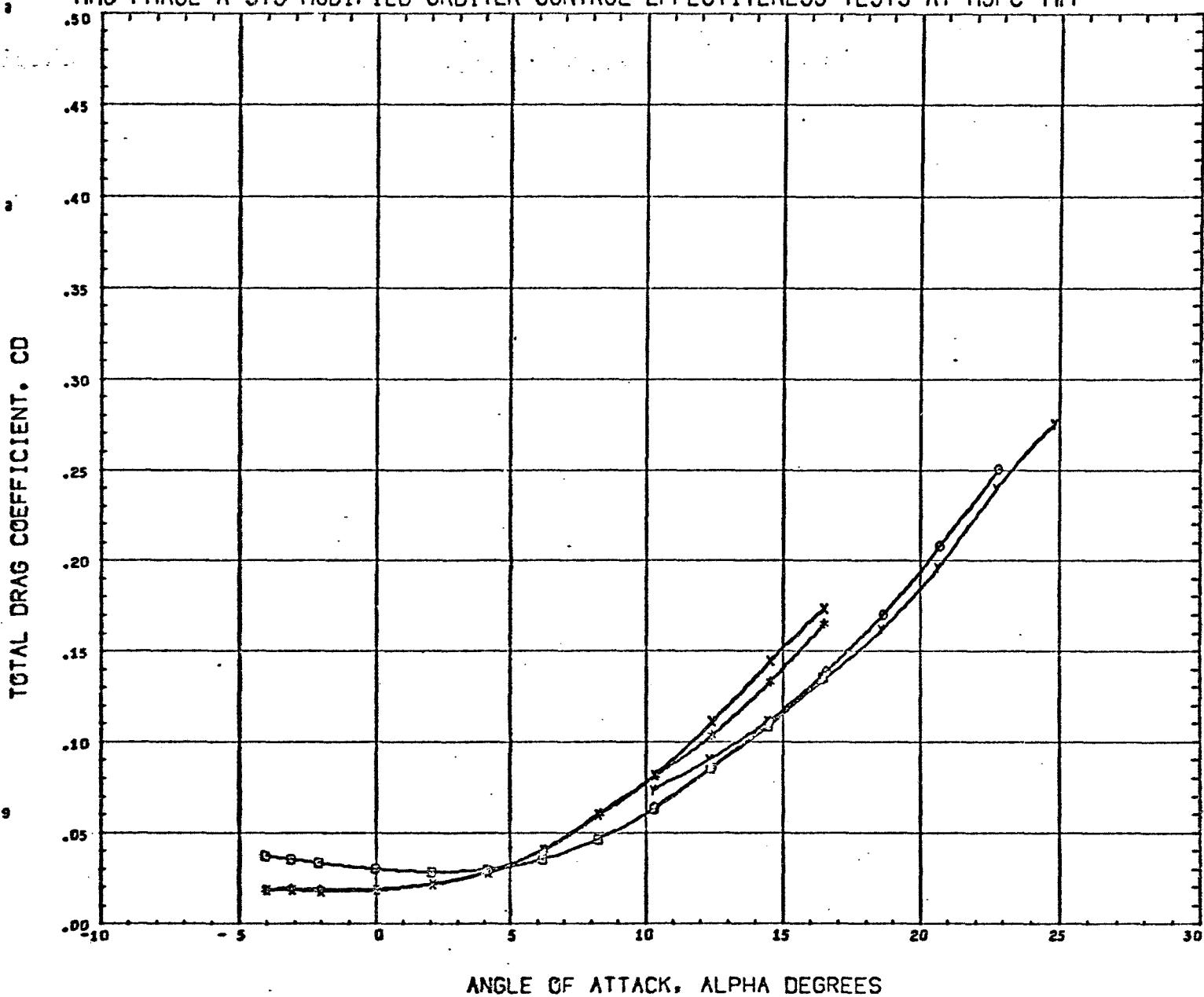
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(T17024)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(T17025)	02 JUL 70		REFL 0.646 FT.
□	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(T17026)	02 JUL 70		REFB 0.405 FT.
○	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(T17028)	02 JUL 70		XMRF 0.456
△	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(T17029)	02 JUL 70		YMRF 0.000
					ZMRF 0.045

REFERENCE FILE.

PAGE 97

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

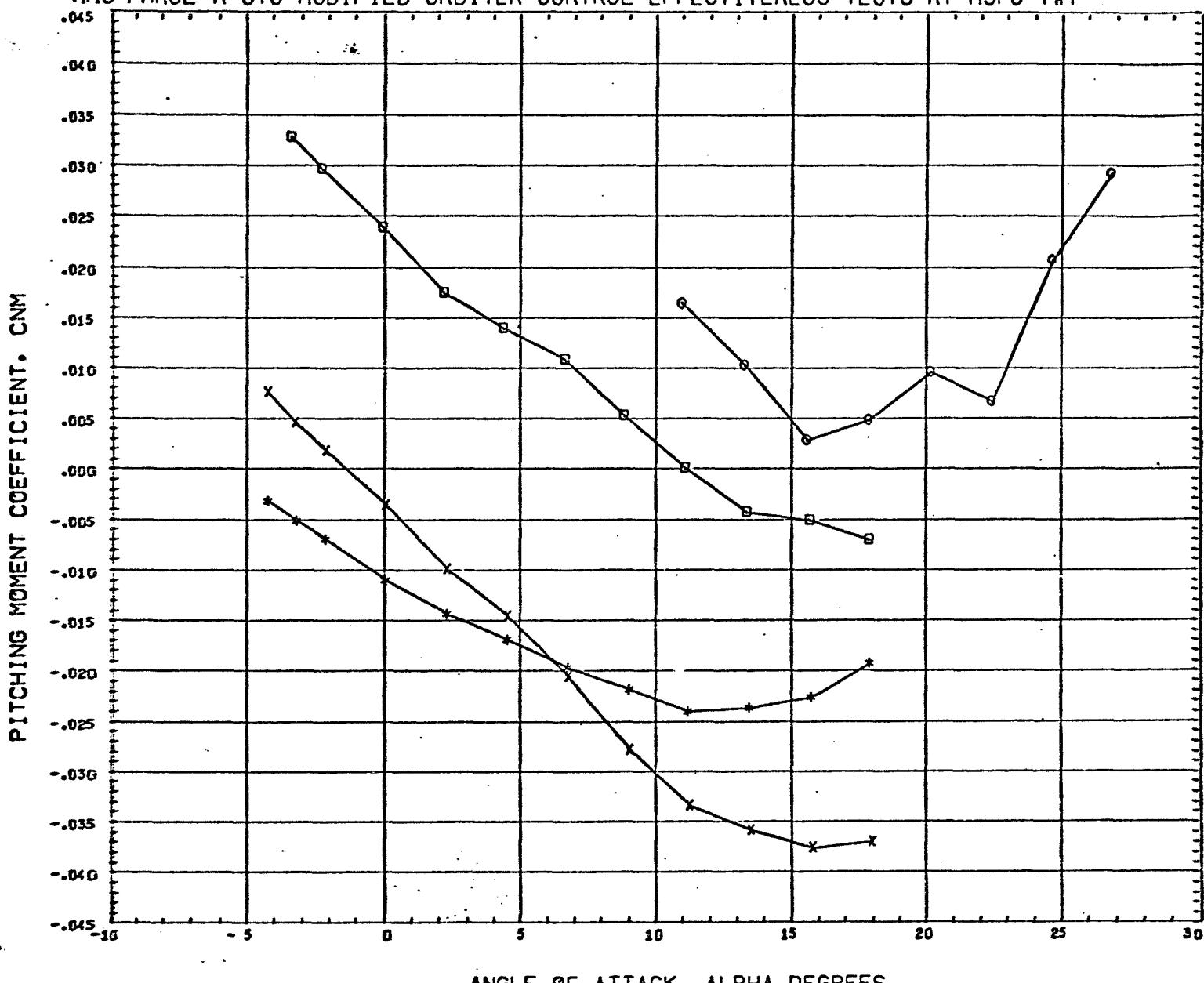


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(T17024)	02 JUL 70	0.395	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(T17025)	02 JUL 70	0.395	REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(T17026)	02 JUL 70	0.395	REFB 0.405 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(T17028)	02 JUL 70	0.395	XMRF 0.406
T	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(T17029)	02 JUL 70	0.395	YMRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION

- \* MSFC 453 MHC MOD ORB E2W2T1R1 E=OFF
- X MSFC 453 MHC MOD ORB E2W2T1E1R1 E=0
- MSFC 453 MHC MOD ORB E2W2T1E1R1 E=-15
- MSFC 453 MHC MOD ORB E2W2T1E1R1 E=-30

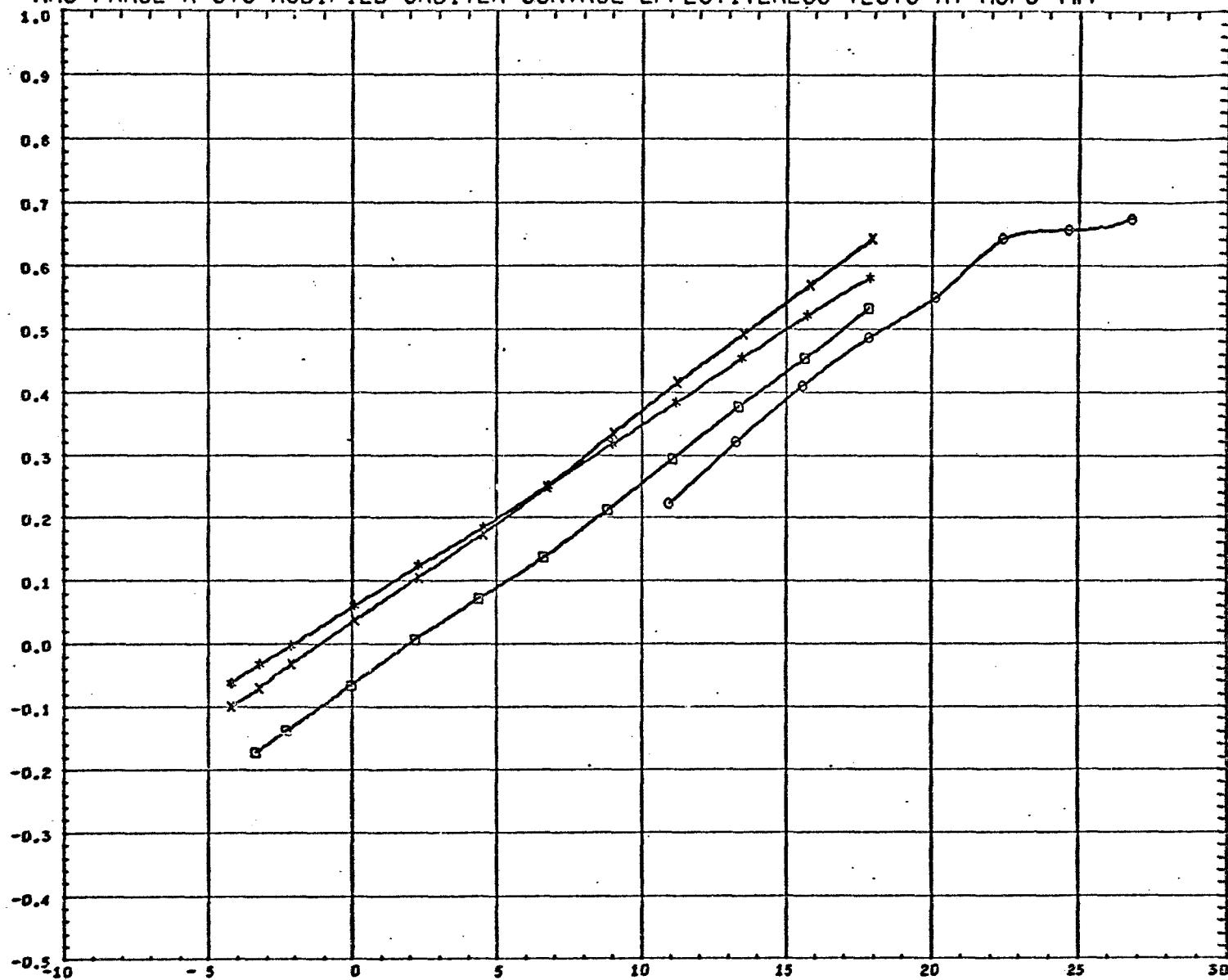
DATA SET	DATE	MACH NUMBER
(C17024)	06 JUL 70	0.794
(C17025)	06 JUL 70	
(C17026)	06 JUL 70	
(C17029)	06 JUL 70	

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.466
YHRF 0.000
ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

NORMAL FORCE COEFFICIENT, CN



ANGLE OF ATTACK, ALPHA DEGREES

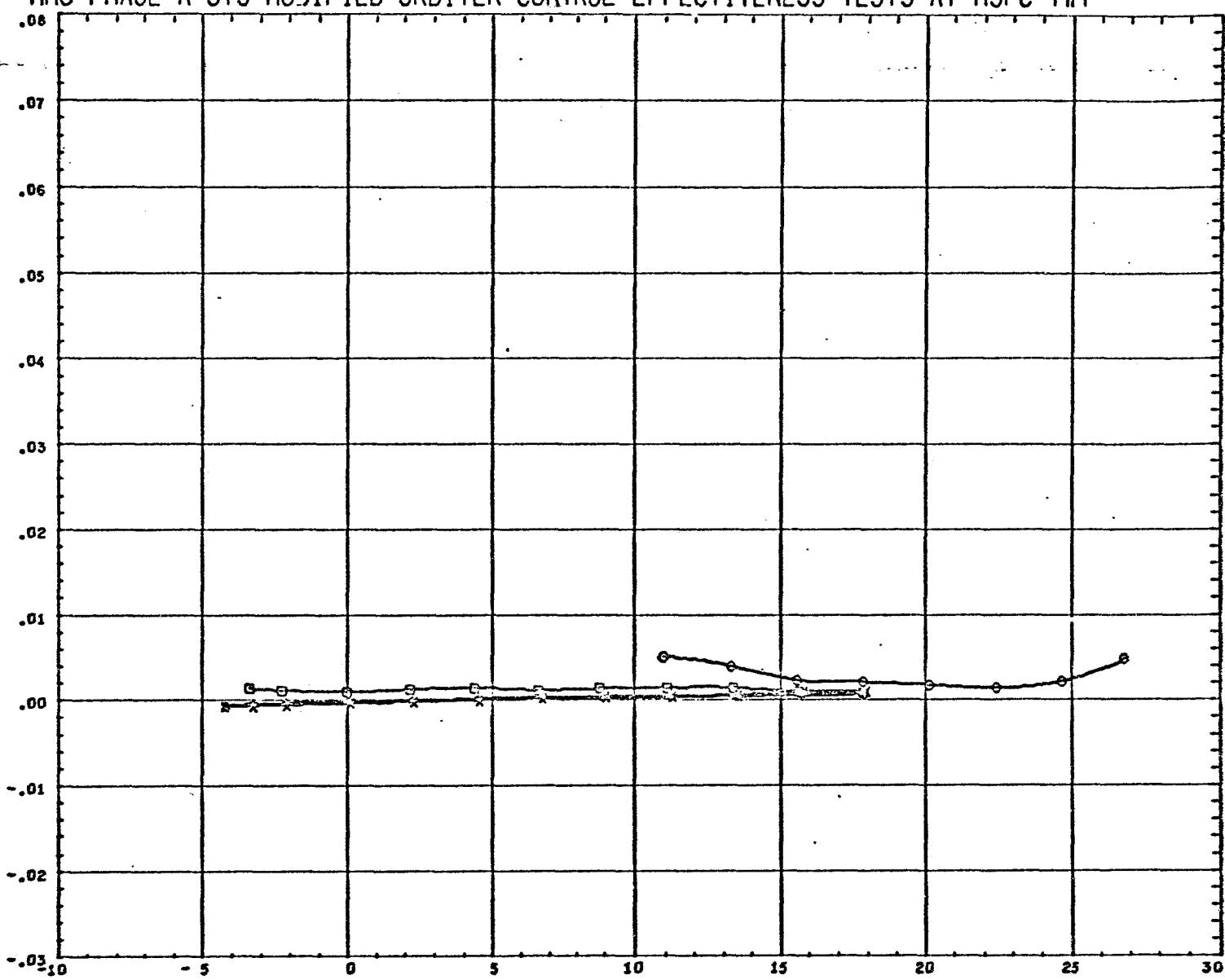
SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(C17024)	02 JUL 70	0.794	REFS 0.116 SG.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(C17025)	02 JUL 70	0.794	REFL 0.646 FT.
□	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(C17026)	02 JUL 70	0.794	REFB 0.405 FT.
○	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(C17029)	02 JUL 70	0.794	XHRF 0.406 YHRF 0.000 ZHRF 0.045

REFERENCE FILE.

PAGE 100

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, C<sub>A</sub>

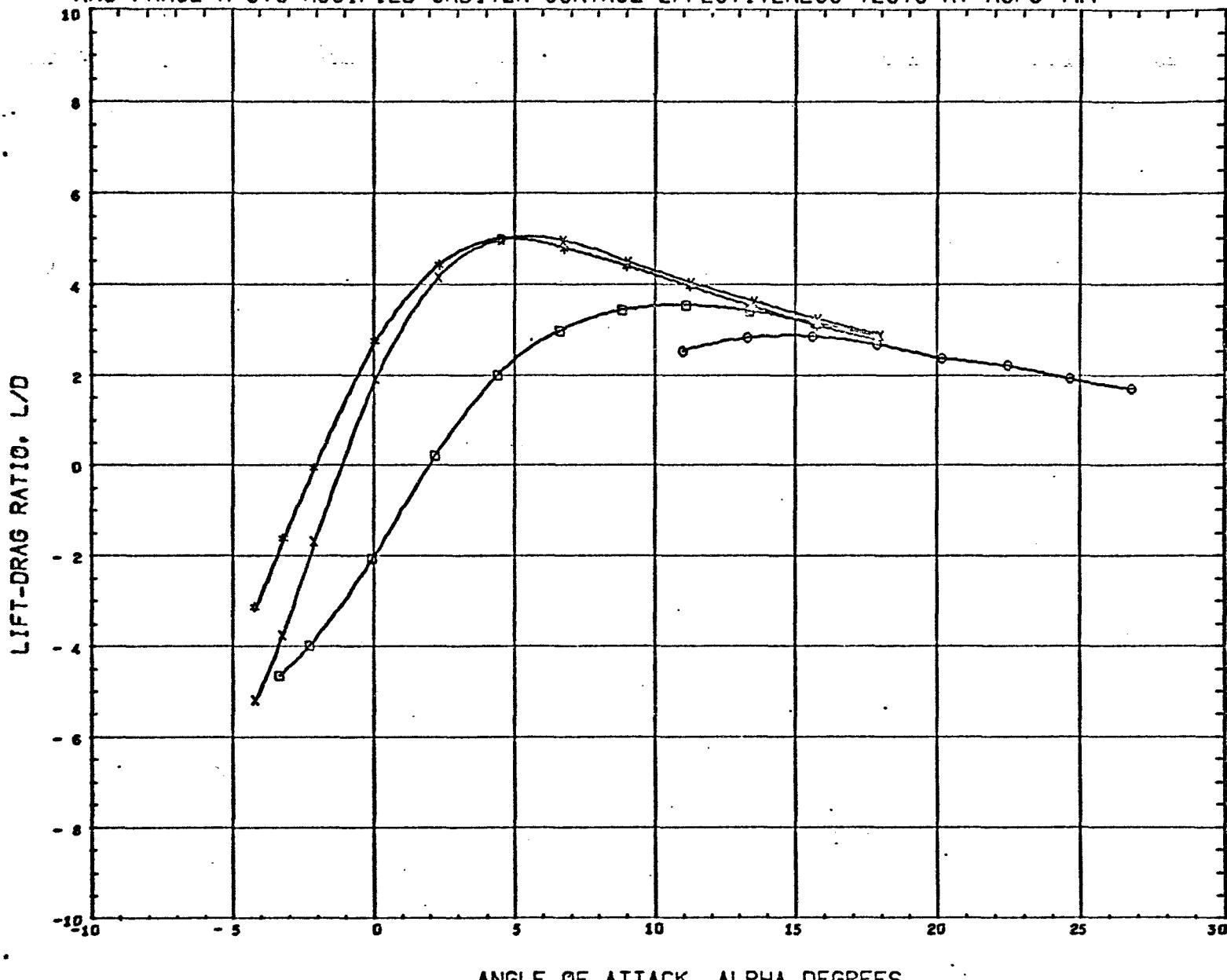


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MCD ORB B2W2T1R1 E=OFF	(C17024)	02 JUL 70	0.794	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=0	(C17025)	02 JUL 70	0.794	REFL 0.646 FT.
□	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-15	(C17026)	02 JUL 70	0.794	REFB 0.405 FT.
○	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-30	(C17029)	02 JUL 70	0.794	XMRP 0.406
					YMRP 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



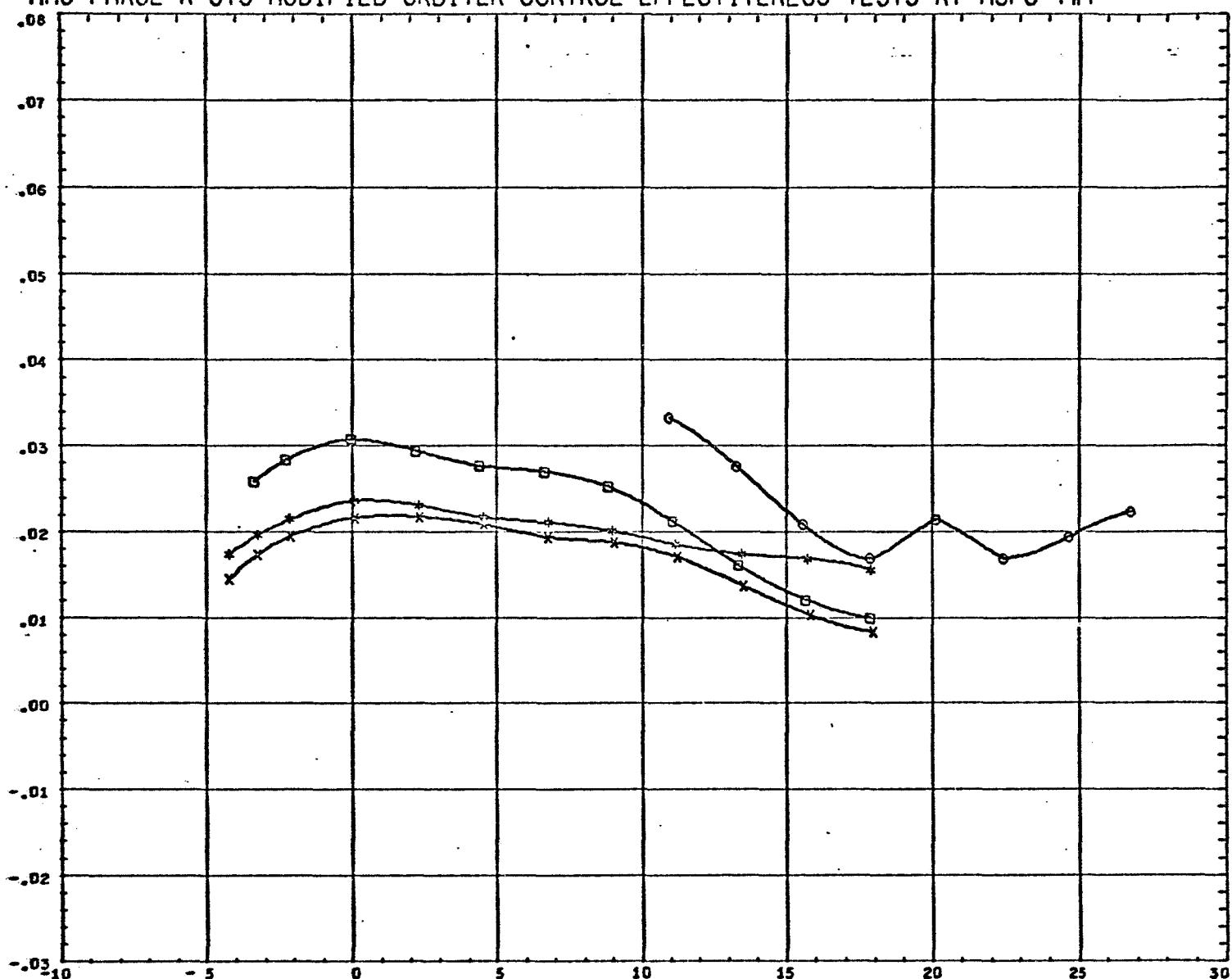
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
●	MSFC 453 MMC HOD ORB B2W2T1E1 R1 E=OFF	(C17024)	02 JUL 70	0.794	REFS 0.116 SQ.FT.
×	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=0	(C17025)	02 JUL 70	0.646 FT.	REFL 0.646 FT.
◻	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=-15	(C17026)	02 JUL 70	0.405 FT.	REFB 0.405 FT.
○	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=-30	(C17029)	02 JUL 70	0.000	XMRF 0.406
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAFORE



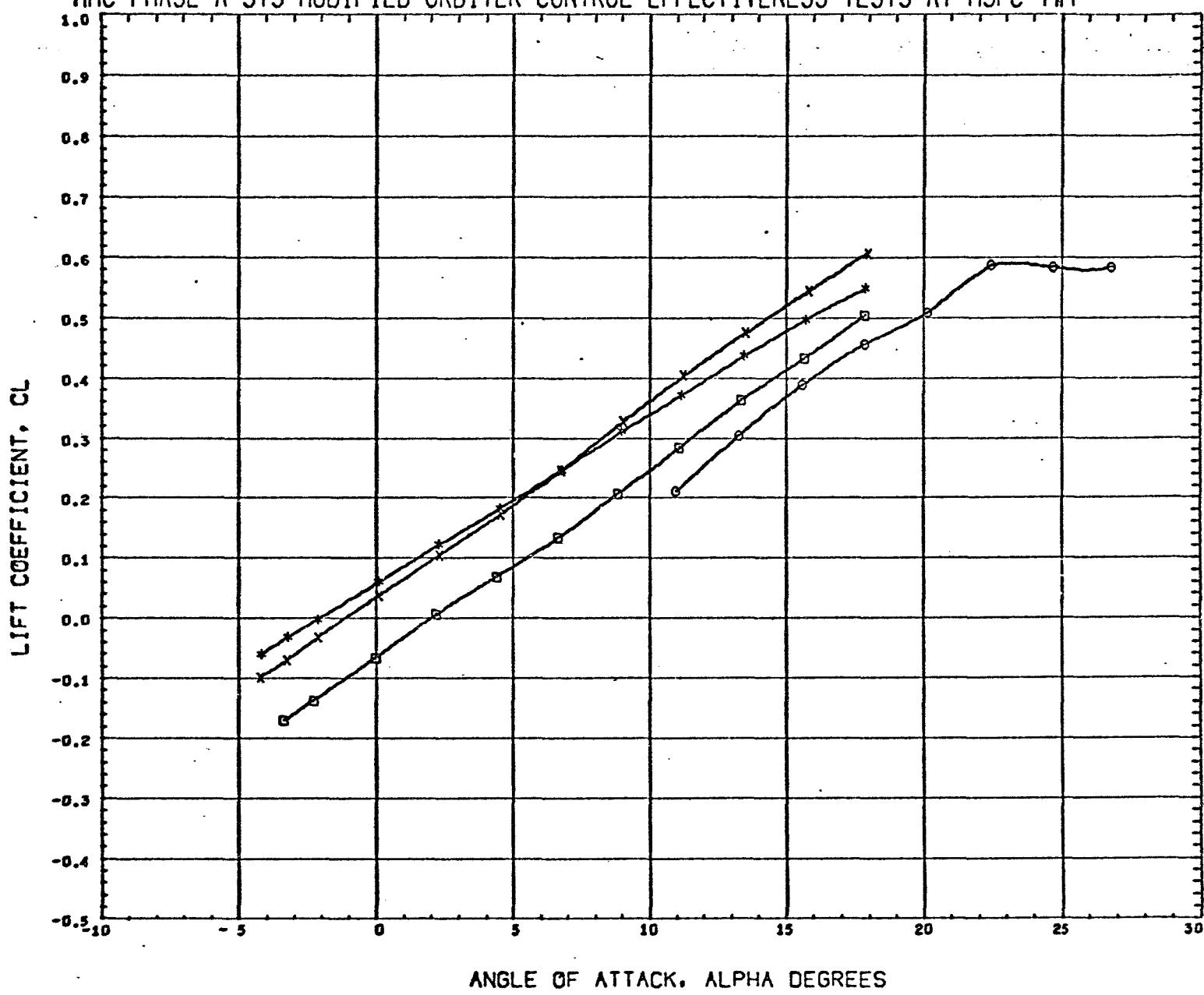
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MHC MOD ORB B2W2T1R1 E=OFF
x	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=0
o	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-15
g	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(C17024)	02 JUL 70	0.794	REFS 0.116 SQ.FT.
(C17025)	02 JUL 70		REFL 0.646 FT.
(C17026)	02 JUL 70		REFB 0.405 FT.
(C17029)	02 JUL 70		XHRF 0.406
			YHRF 0.000
			ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



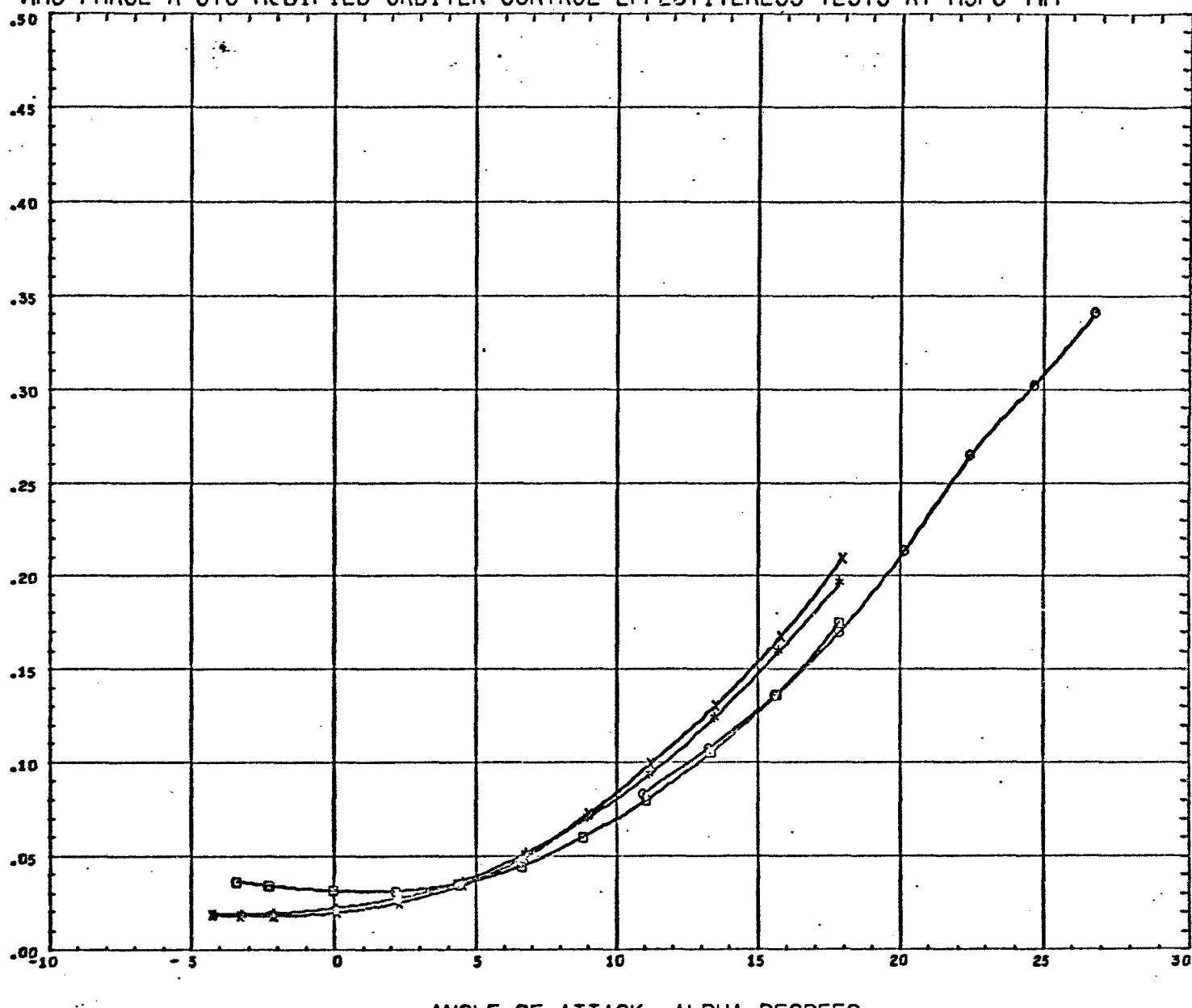
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(U17024)	02 JUL 70	0.794	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(U17025)	02 JUL 70	0.794	REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(U17026)	02 JUL 70	0.794	REFB 0.405 FT.
Q	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(U17029)	02 JUL 70	0.794	XHRF 0.406 YHRF 0.000 ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT, CD



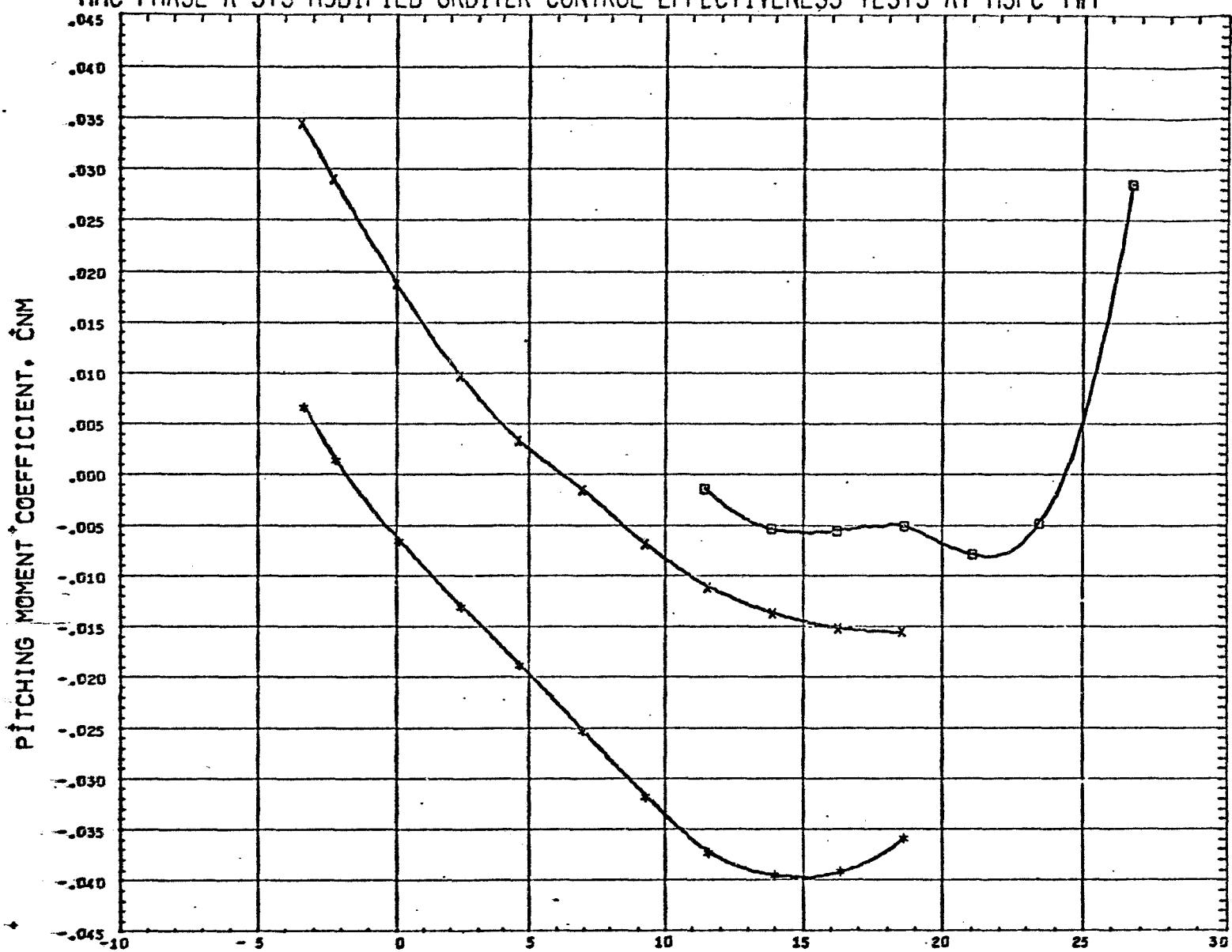
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION  
 \* MSFC 453 MMC MOD ORB B2W2T1E1 E=OFF  
 X MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0  
 G MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15  
 O MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(U17024)	02 JUL 70	0.794	REFS 0.116 SQ.FT.
(U17025)	02 JUL 70		REFL 0.646 FT.
(U17026)	02 JUL 70		REFB 0.405 FT.
(U17029)	02 JUL 70		XHRF 0.456
			YHRF 0.080
			ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL CONFIGURATION DESCRIPTION

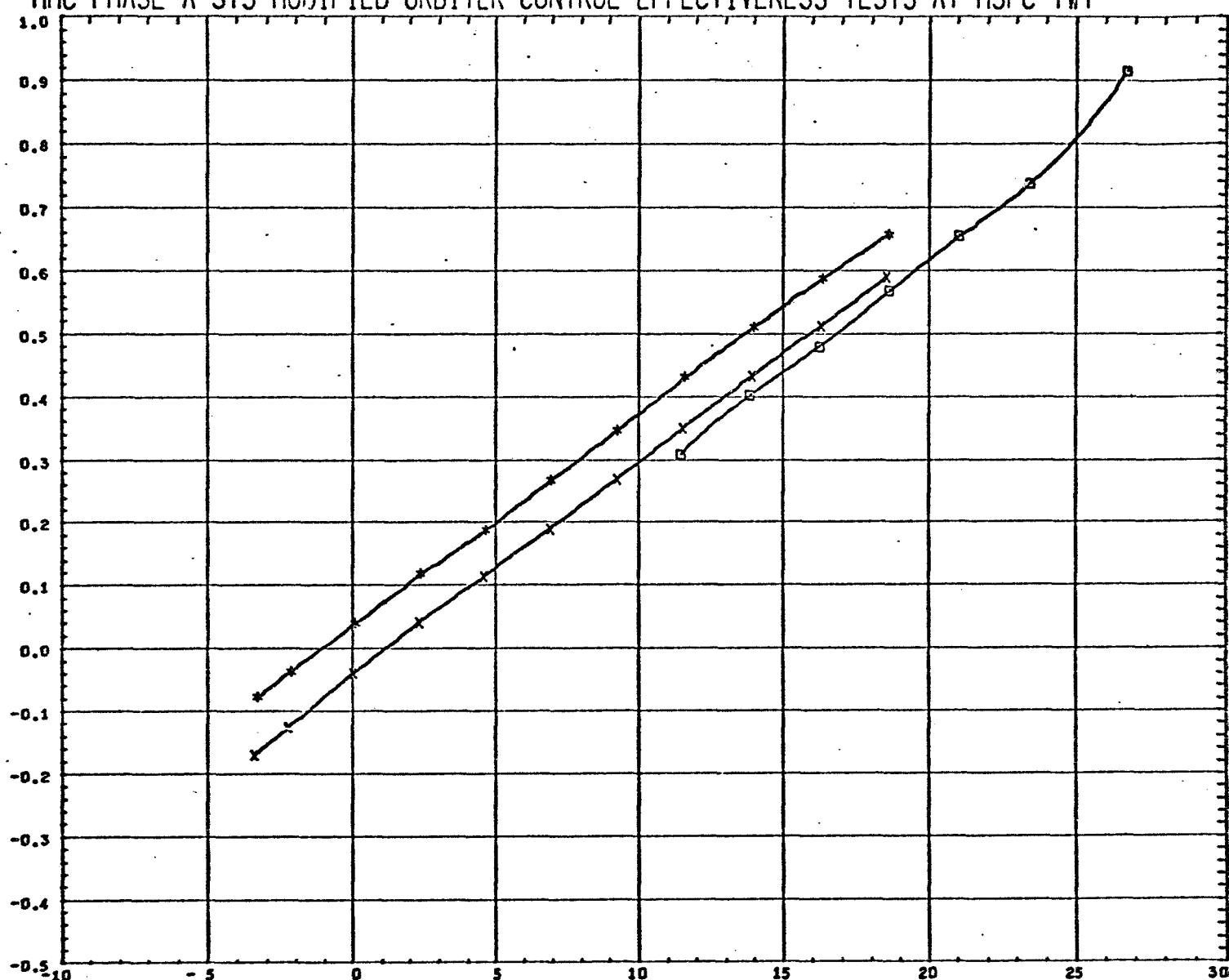
\* MSFC 453 MMC MOD ORB S2W2T1E1R1 E=0  
 X MSFC 453 MMC MOD ORB S2W2T1E1R1 E=-15  
 C MSFC 453 MMC MOD ORB S2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(D17025)	02 JUL 70	0.995	REFS 0.116 SQ.FT.
(D17026)	02 JUL 70	0.995	REFL 0.646 FT.
(D17029)	02 JUL 70	0.995	REFB 0.495 FT. XMRF 0.496 YMRF 0.600 ZMRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

NORMAL FORCE COEFFICIENT, CN



ANGLE OF ATTACK, ALPHA DEGREES

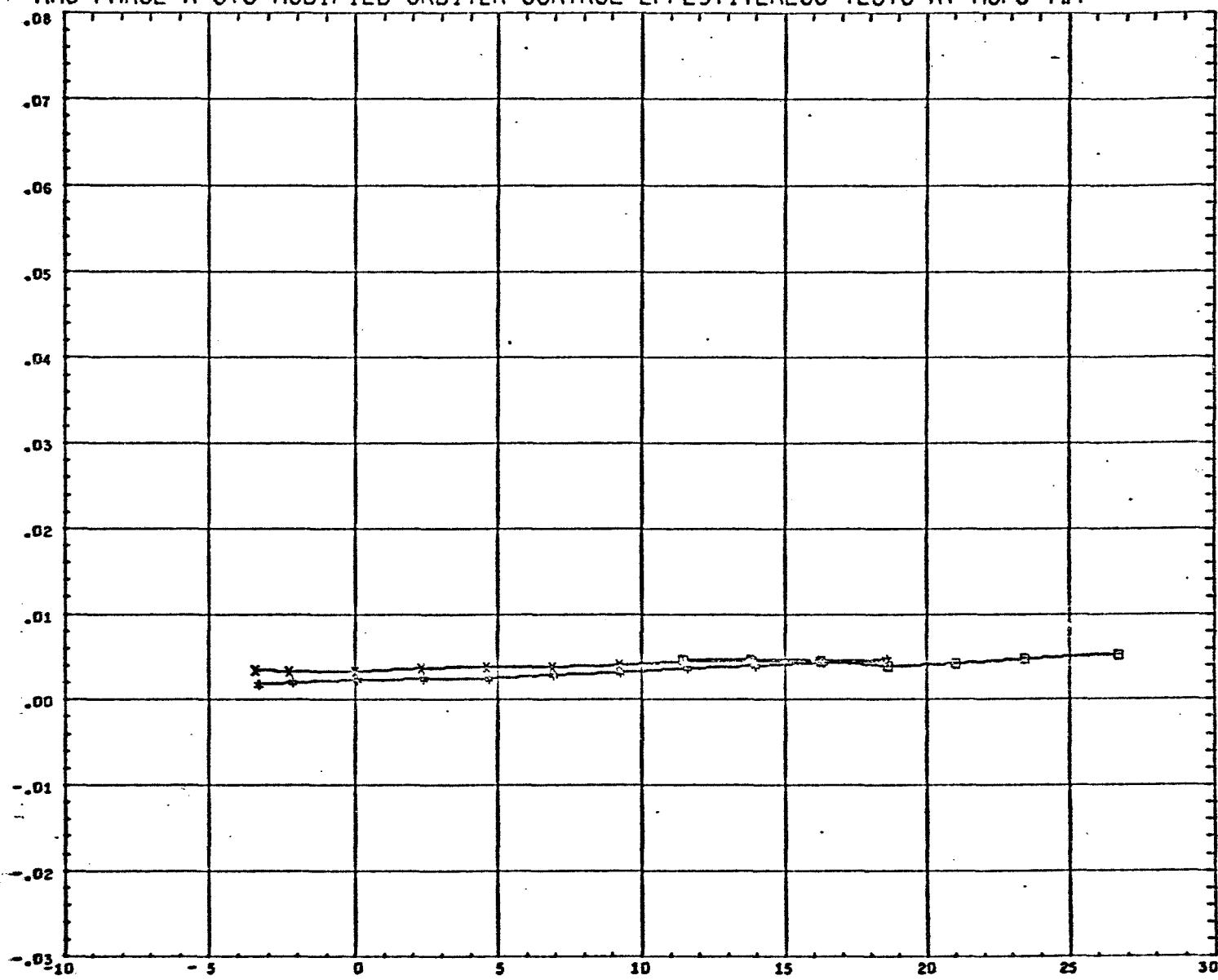
SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MMC MCC ORB B2W2T1E1R1 E=0
x	MSFC 453 MMC MCC ORB B2W2T1E1R1 E=-15
o	MSFC 453 MMC MCC ORB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(D17025)	02 JUL 70	0.995	REFS 0.116 SQ.FT.
(D17026)	02 JUL 70		REFL 0.646 FT.
(D17029)	02 JUL 70		REFB 0.495 FT.
			XHRF 0.406
			YHRF 0.000
			ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, C<sub>A,BASE</sub>

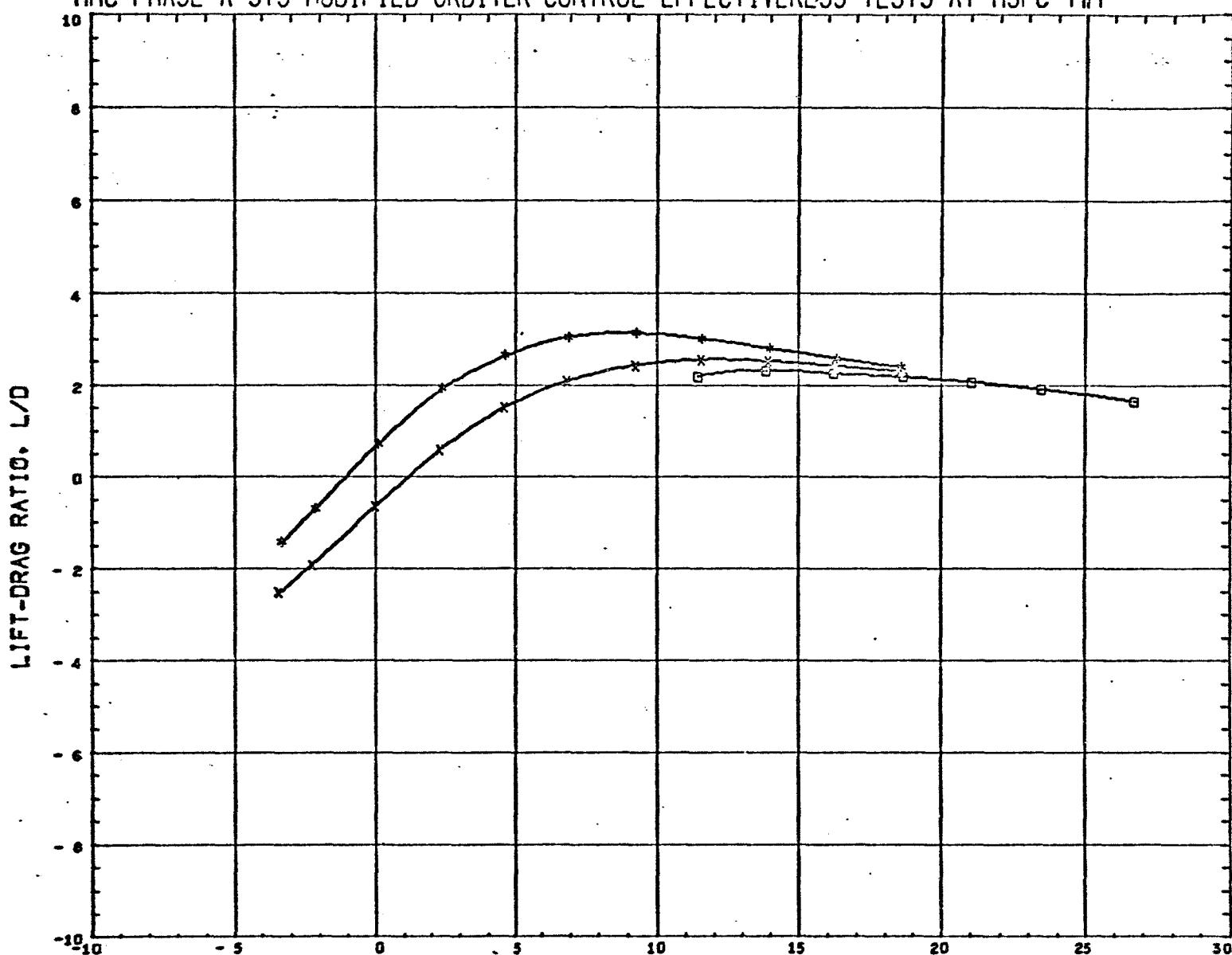


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2TIE1R1 E=0	(D17025)	02 JUL 70	0.995	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOD ORB B2W2TIE1R1 E=-15	(D17026)	02 JUL 70	0.995	REFL 0.646 FT.
o	MSFC 453 MMC MOD ORB B2W2TIE1R1 E=-30	(D17029)	02 JUL 70	0.995	REFB 0.405 FT. XMRF 0.406 YMRF 0.000 ZMRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION

\* MSFC 453 MMC MOD ORB B2W2TIE1R1 E=0  
 X MSFC 453 MMC MOD ORB B2W2TIE1R1 E=-15  
 G MSFC 453 MMC MOD ORB B2W2TIE1R1 E=-30

DATA SET DATE MACH NUMBER

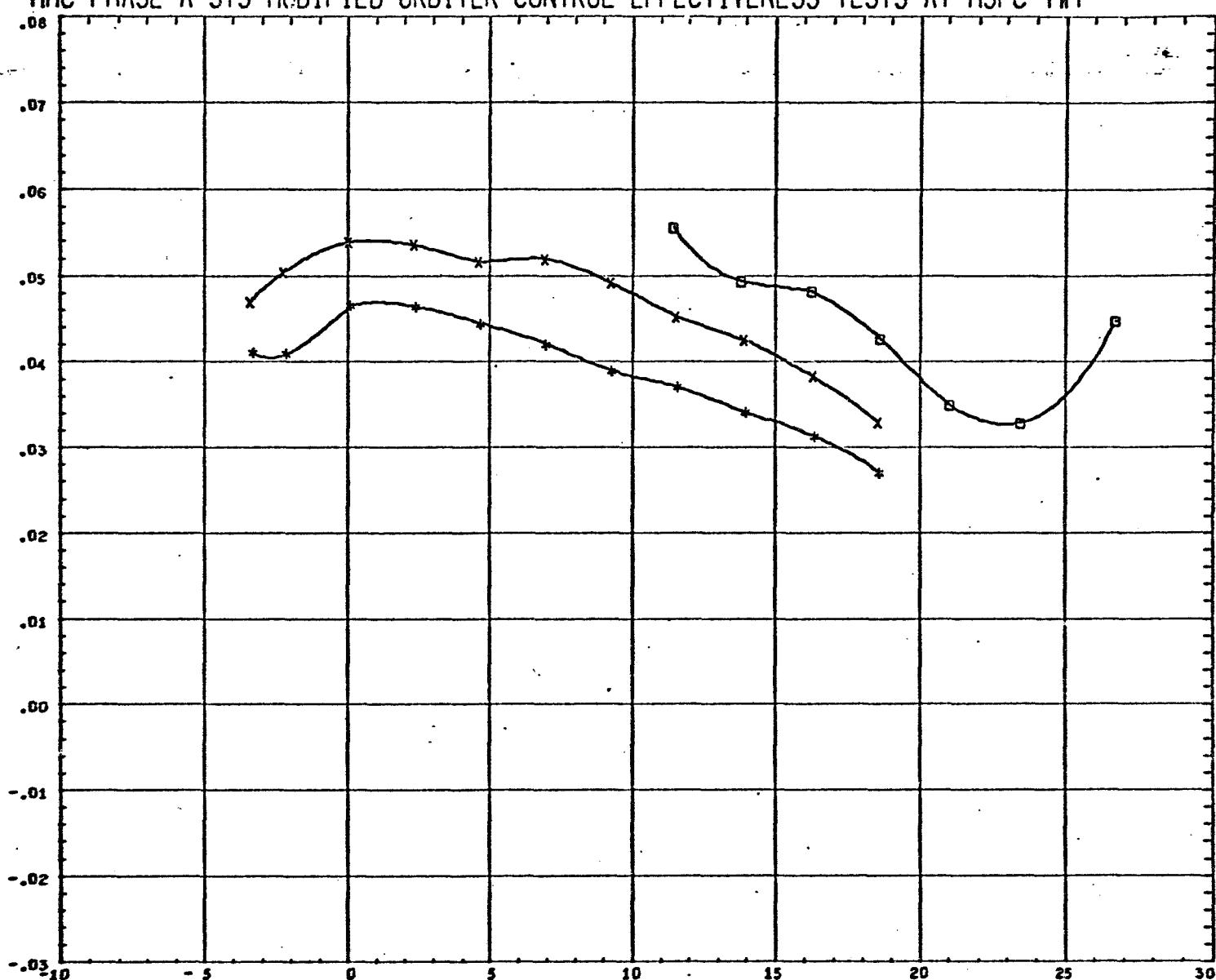
(D17025) 02 JUL 70 0.995  
 (D17026) 02 JUL 70  
 (D17029) 02 JUL 70

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.406
YMRP 0.000
ZMRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAF<sub>0</sub>



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION

- MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0
- ✗ MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15
- ◻ MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30

DATA SET DATE MACH NUMBER

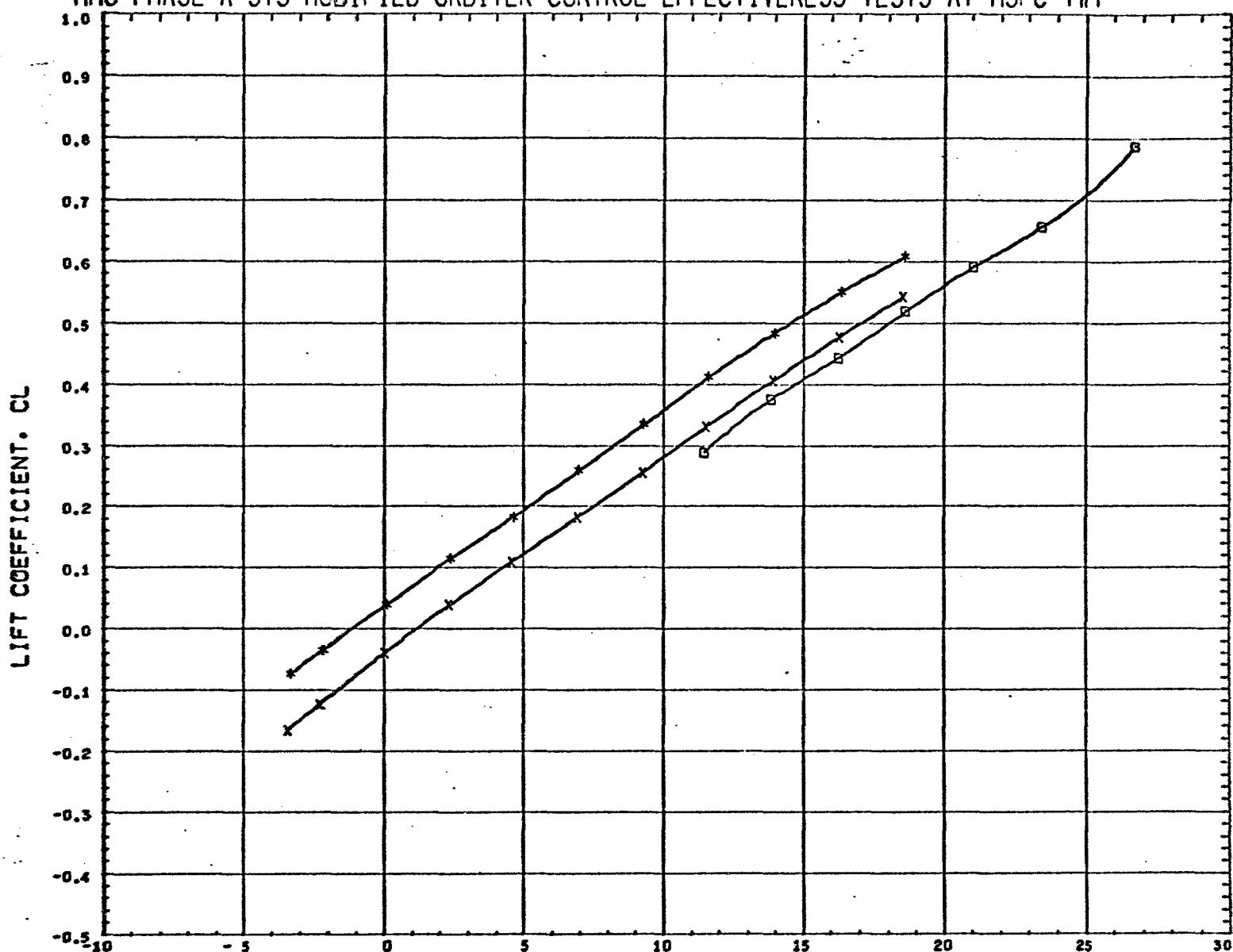
- (D17025) 02 JUL 70 0.995
- (D17026) 02 JUL 70
- (D17029) 02 JUL 70

REFERENCE INFORMATION

REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.500	
ZHRF	0.045	

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MHC MCC GRB B2W2TIEIRI E=0
x	MSFC 453 MHC MCC GRB B2W2TIEIRI E=-15
o	MSFC 453 MHC MCC GRB B2W2TIEIRI E=-30

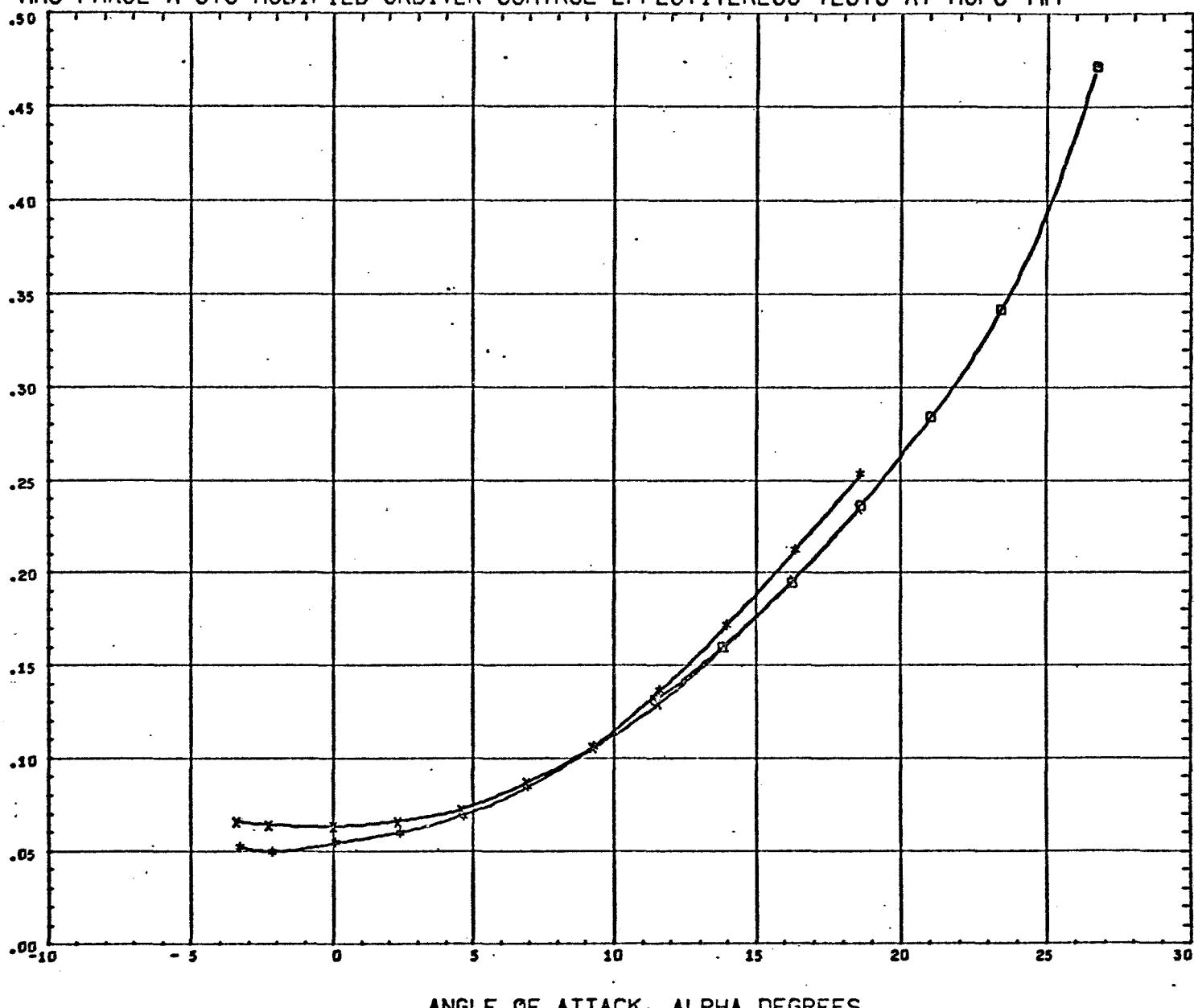
DATA SET	DATE	MACH NUMBER
(V17025)	02 JUL 70	0.995
(V17026)	02 JUL 70	
(V17029)	02 JUL 70	

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XMRP 0.406
YMRP 0.000
ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT, CD



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION

- \* MSFC 453 MMC M00 ORB B2W2T1E1R1 E=0
- X MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-15
- G MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-30

DATA SET DATE MACH NUMBER

- (V17025) 02 JUL 70 0.995
- (V17026) 02 JUL 70
- (V17029) 02 JUL 70

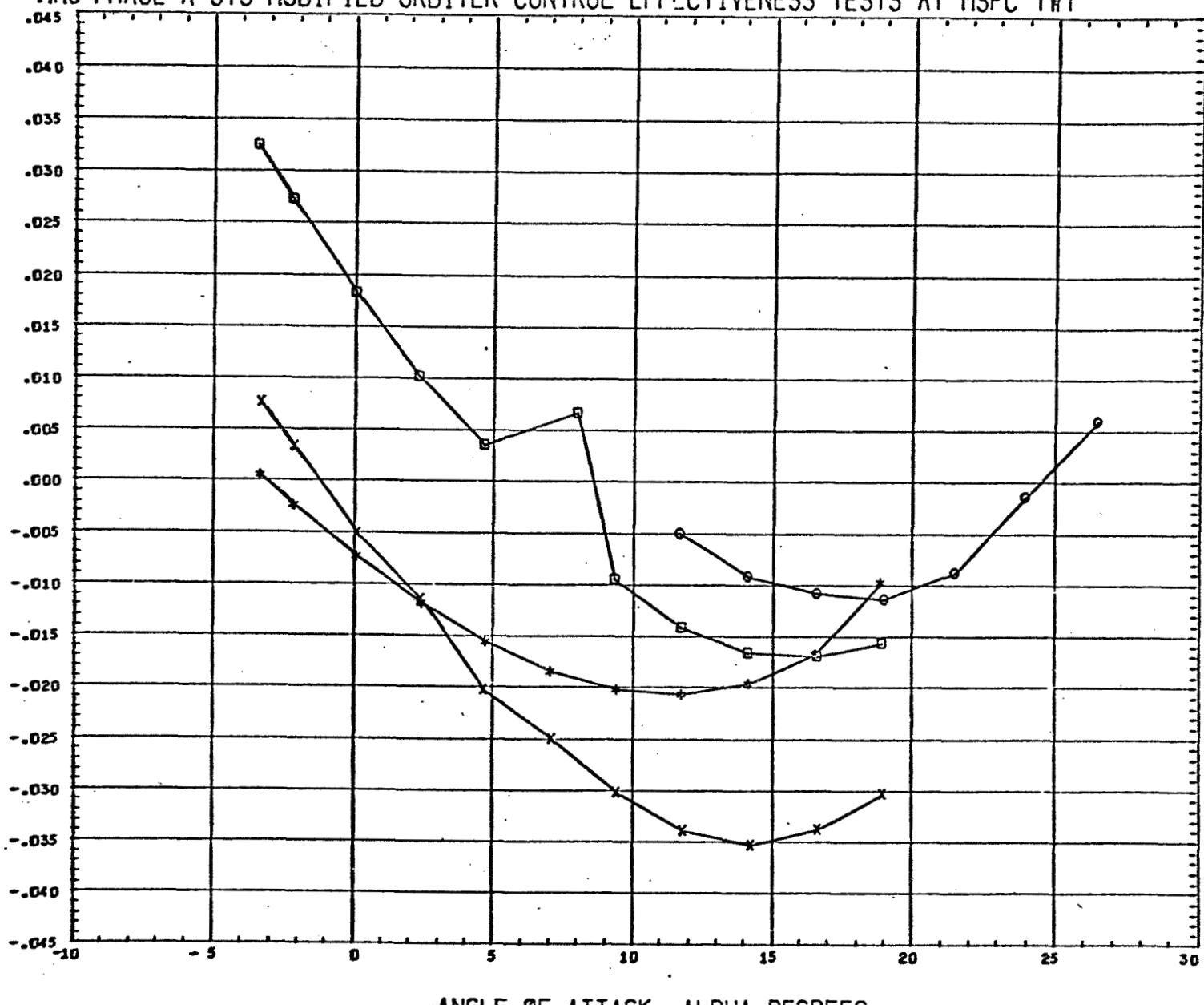
REFERENCE INFORMATION

REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRP	0.406	
YMRP	0.000	
ZMRP	0.045	

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION

\* MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF  
 X MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0  
 □ MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15  
 O MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30

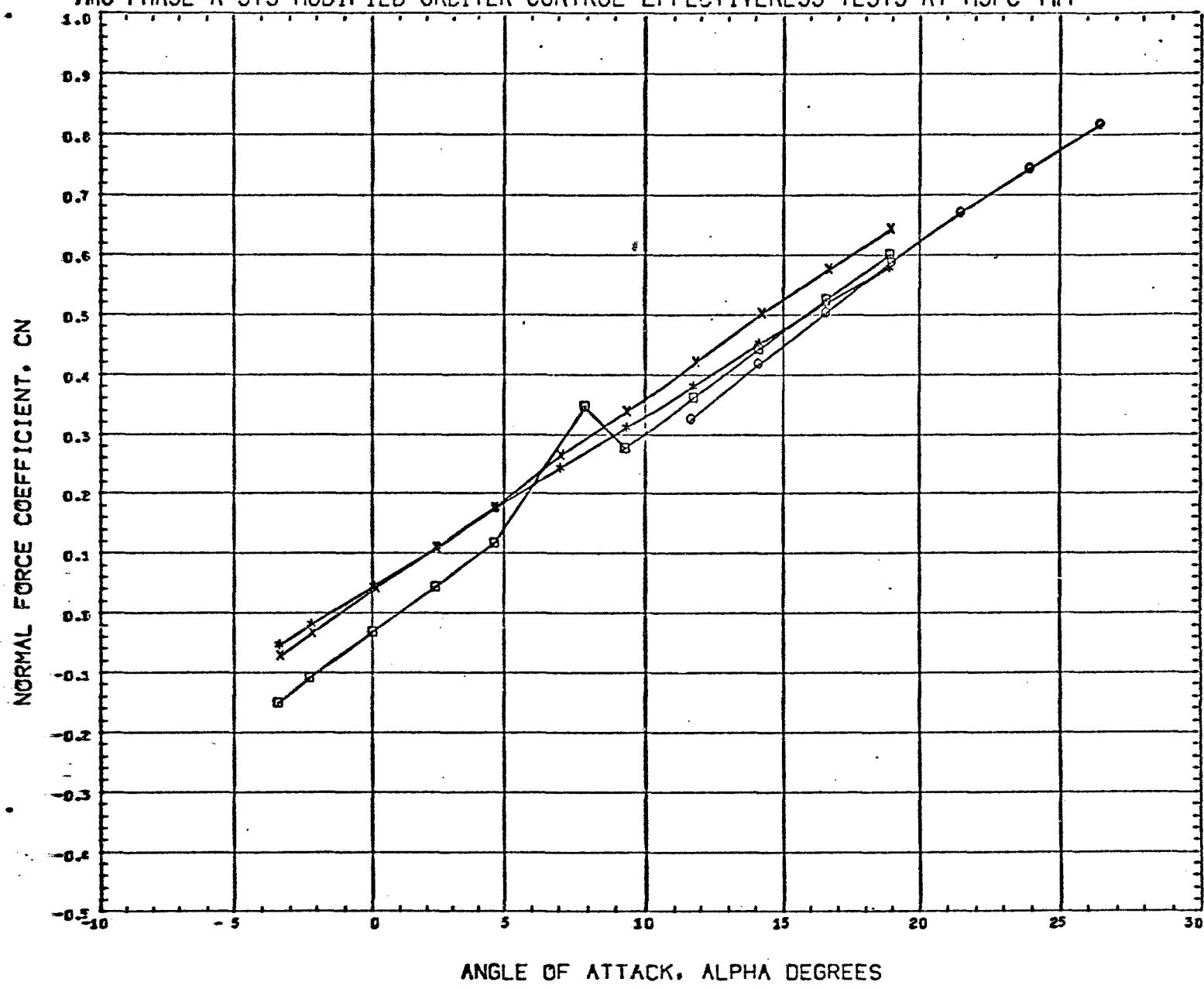
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 (E17025) 06 JUL 70  
 (E17026) 06 JUL 70  
 (E17029) 06 JUL 70

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.406
YHRF 0.000
ZHRF 0.045

REFERENCE FILE.

MHC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

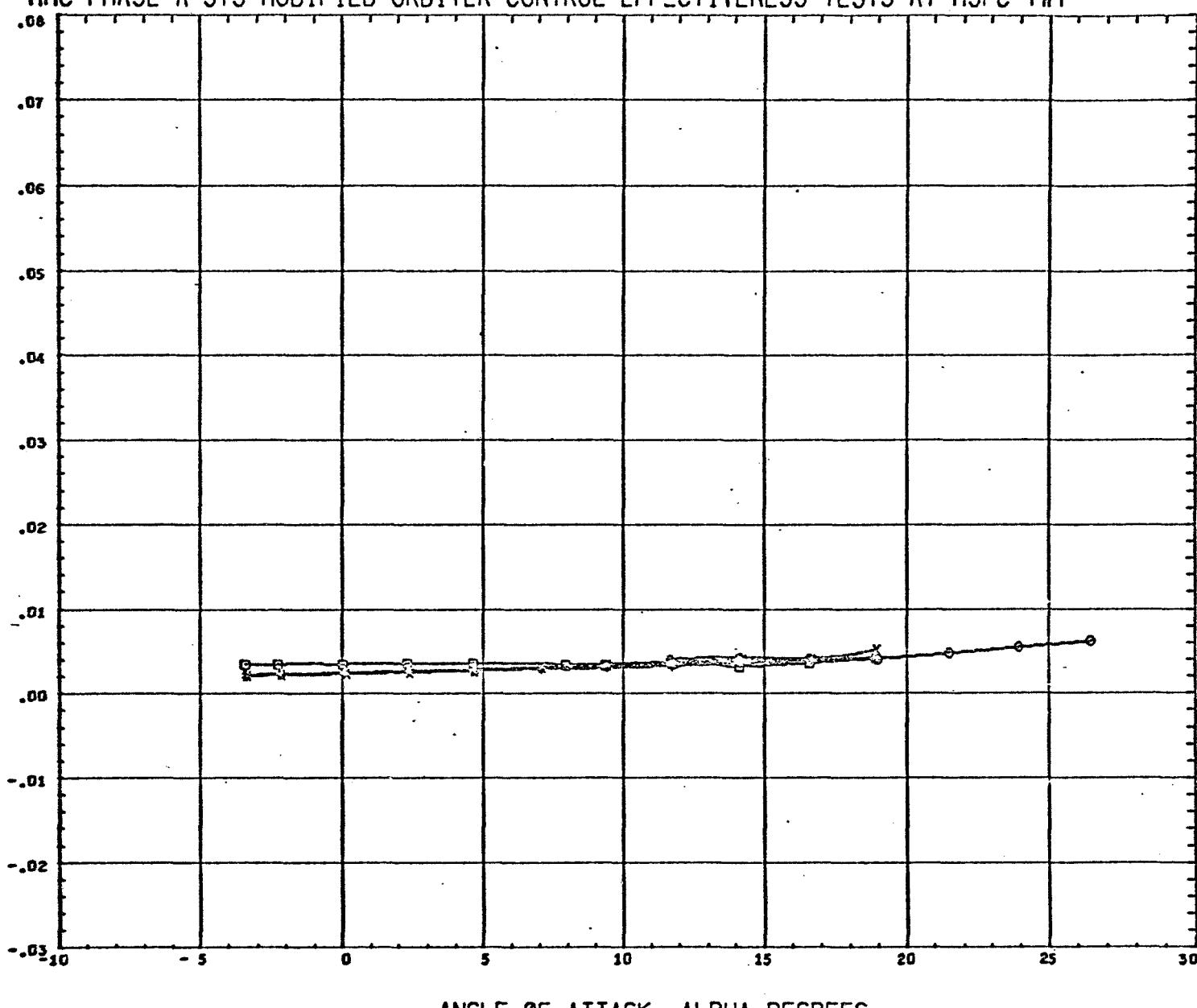
SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MHC MOD ORB B2W2T1R1 E=OFF
X	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=0
◻	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-15
○	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(E17024)	06 JUL 70	1.198	REFS 0.116 SQ.FT.
(E17025)	06 JUL 70		REFL 0.646 FT.
(E17026)	06 JUL 70		REFB 0.405 FT.
(E17029)	06 JUL 70		XHRF 0.466
			YHRF 0.500
			ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, C<sub>A,BASE</sub>

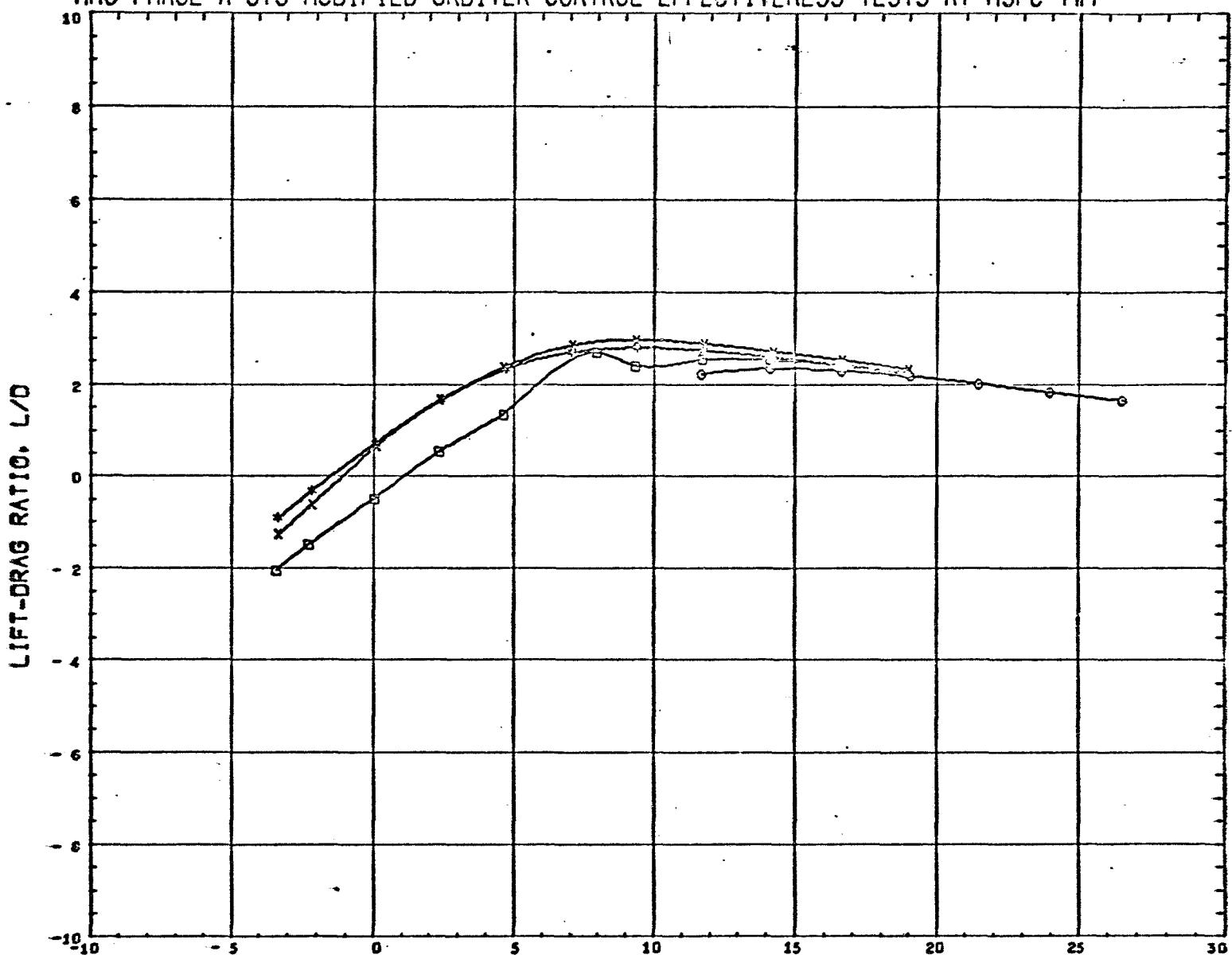


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
●	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(E17024)	02 JUL 70	1.198	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(E17025)	02 JUL 70		REFL 0.546 FT.
○	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(E17026)	02 JUL 70		REFB 0.405 FT.
○	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(E17029)	02 JUL 70		XHRF 0.406 YHRF 0.000 ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



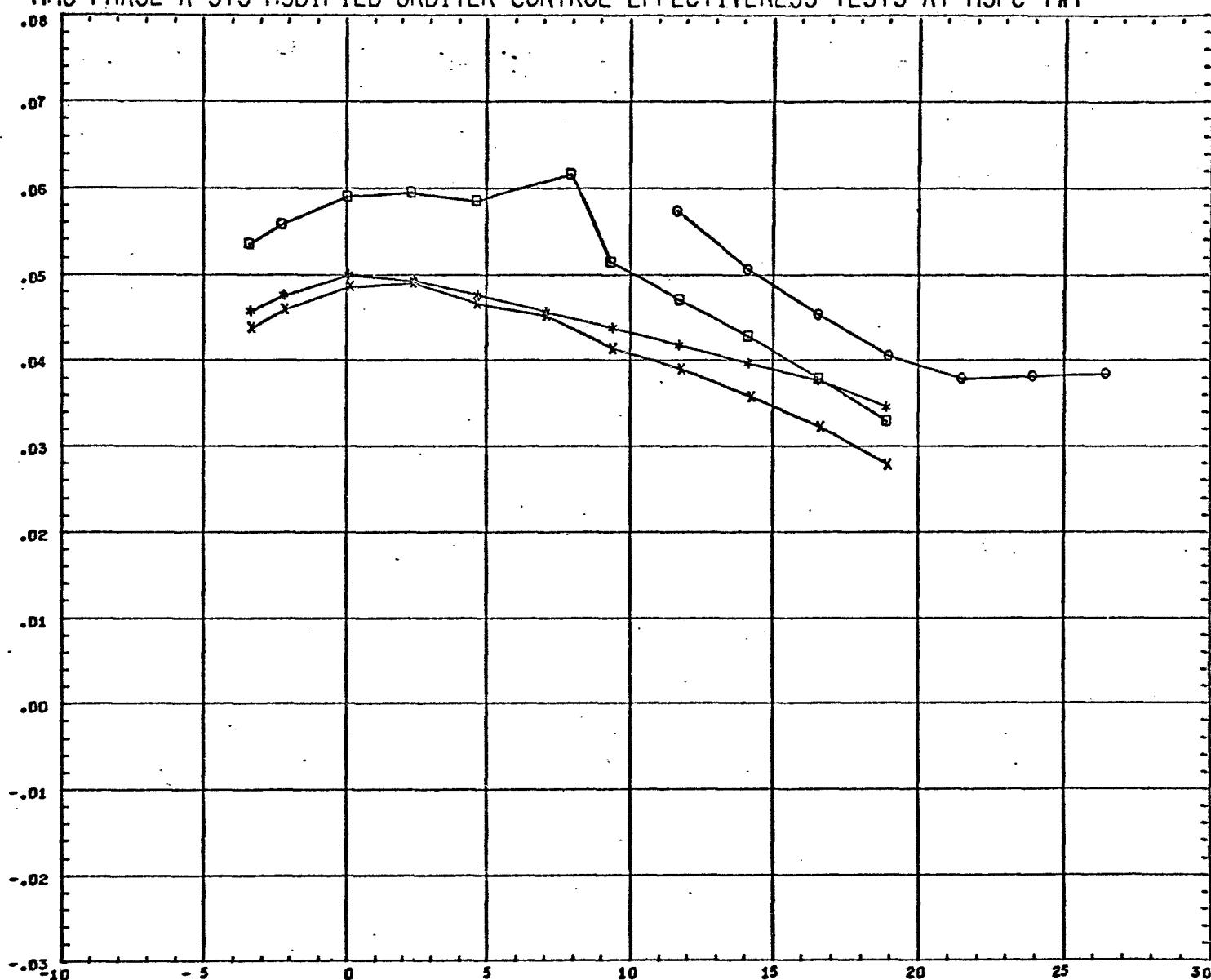
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOG ORB B2W2T1R1 E=OFF	(E17024)	02 JUL 70	1.198	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOG ORB B2W2T1E1R1 E=0	(E17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOG ORB B2W2T1E1R1 E=-15	(E17026)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MMC MOG ORB B2W2T1E1R1 E=-30	(E17029)	02 JUL 70		XHRF 0.406
					YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAF<sub>0</sub>



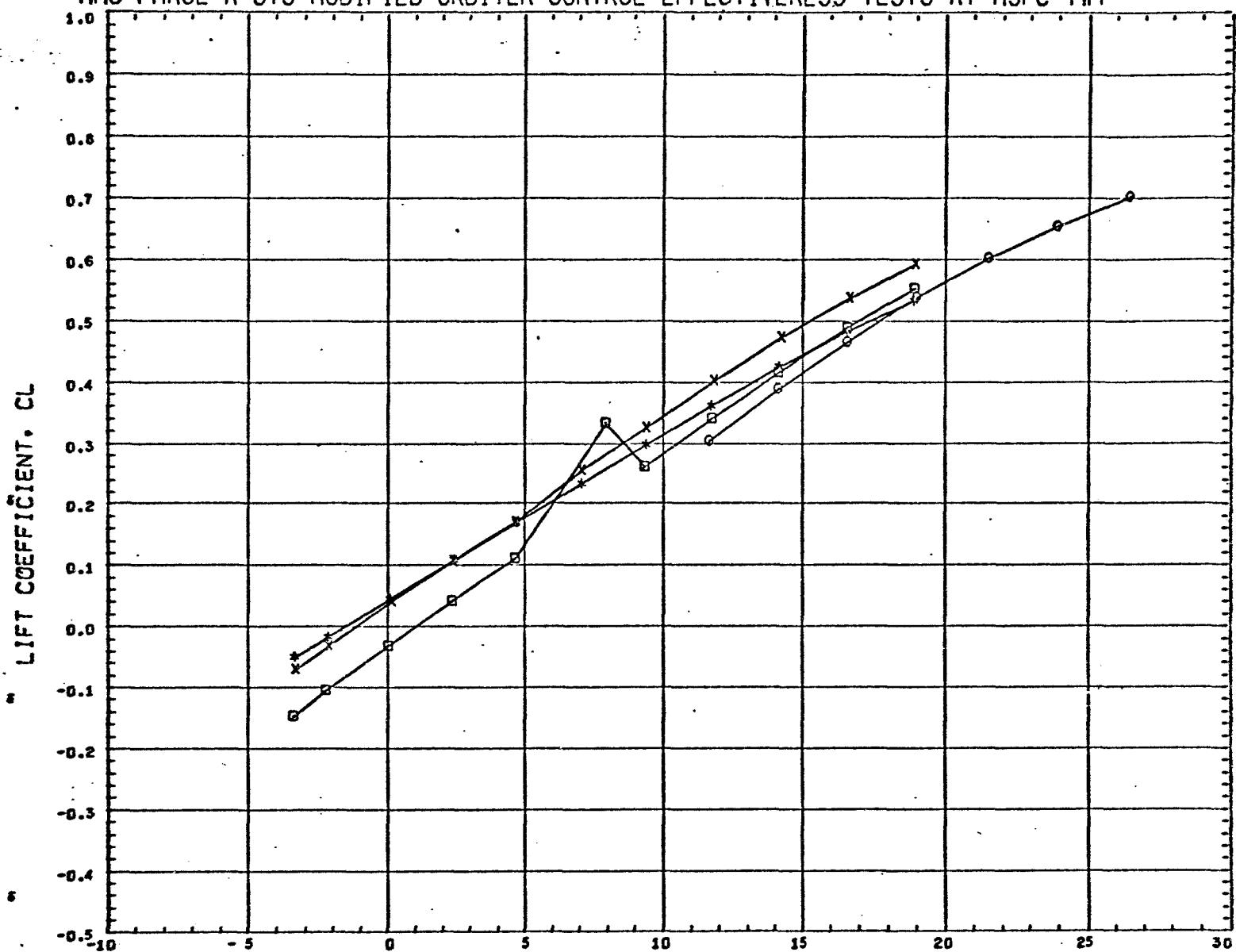
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION  
 \* MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF  
 X MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0  
 □ MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15  
 O MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(E17G24)	06 JUL 70	1.198	REFS 0.116 SQ.FT.
(E17G25)	06 JUL 70		REFL 0.646 FT.
(E17G26)	06 JUL 70		REFB 0.405 FT.
(E17G29)	06 JUL 70		XHRF 0.466
			YHRF 0.660
			ZHRF 0.645

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

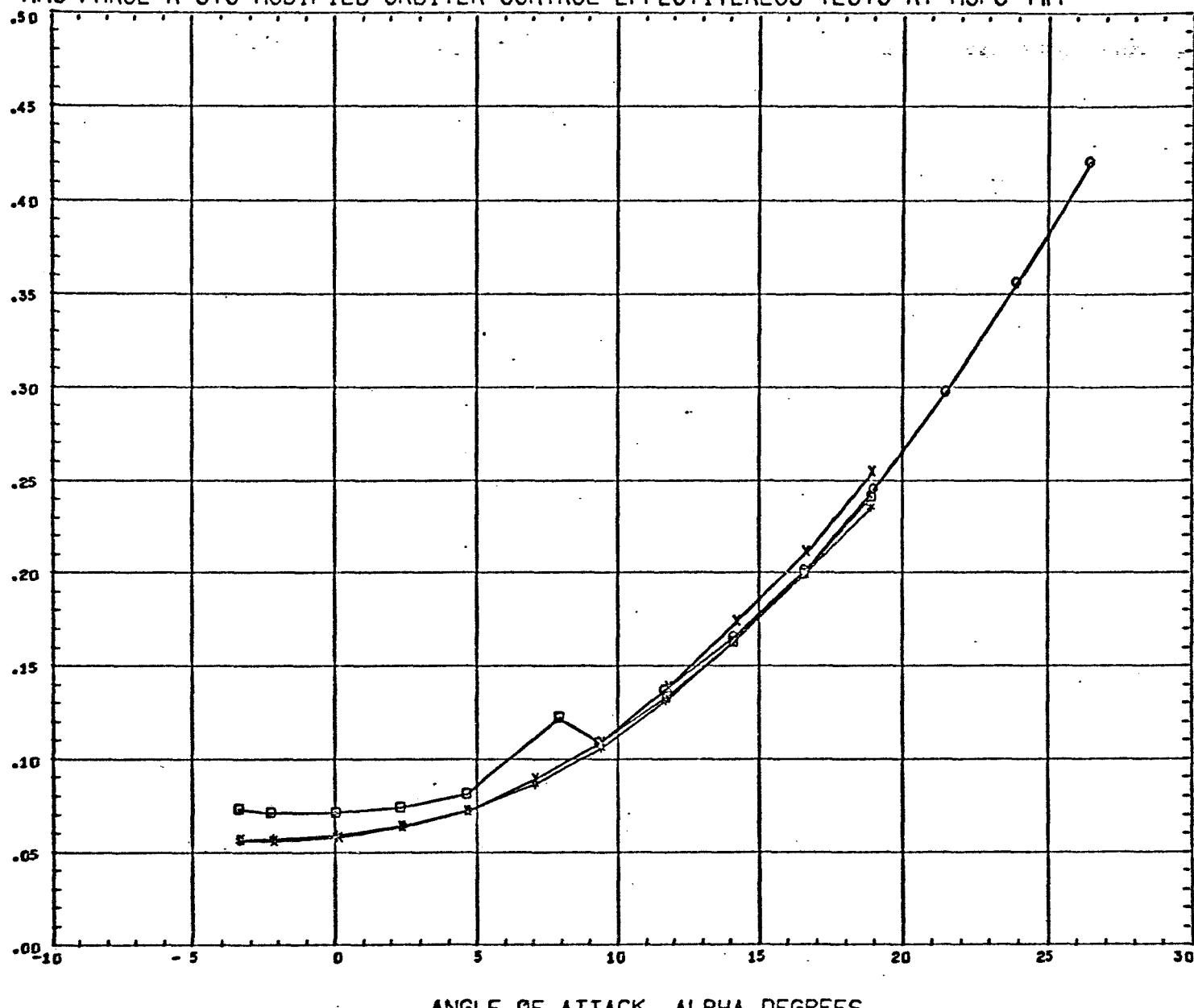
SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MMC MCD ORB B2W2T1R1 E=OFF
X	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=0
□	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-15
○	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(W17G24)	66 JUL 70	1.198	REFS 0.116 SQ.FT.
(W17G25)	66 JUL 70		REFL 0.646 FT.
(W17G26)	66 JUL 70		REFB 0.405 F1.
(W17G29)	66 JUL 70		XHRF 0.406
			YHRF 0.000
			ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT, CD



ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL CONFIGURATION DESCRIPTION

\* MSFC 453 MMC MOD ORB E2W2T1R1 E=OFF  
 X MSFC 453 MMC MOD ORB E2W2T1E1R1 E=0  
 □ MSFC 453 MMC MOD ORB E2W2T1E1R1 E=-15  
 ○ MSFC 453 MMC MOD ORB E2W2T1E1R1 E=-30

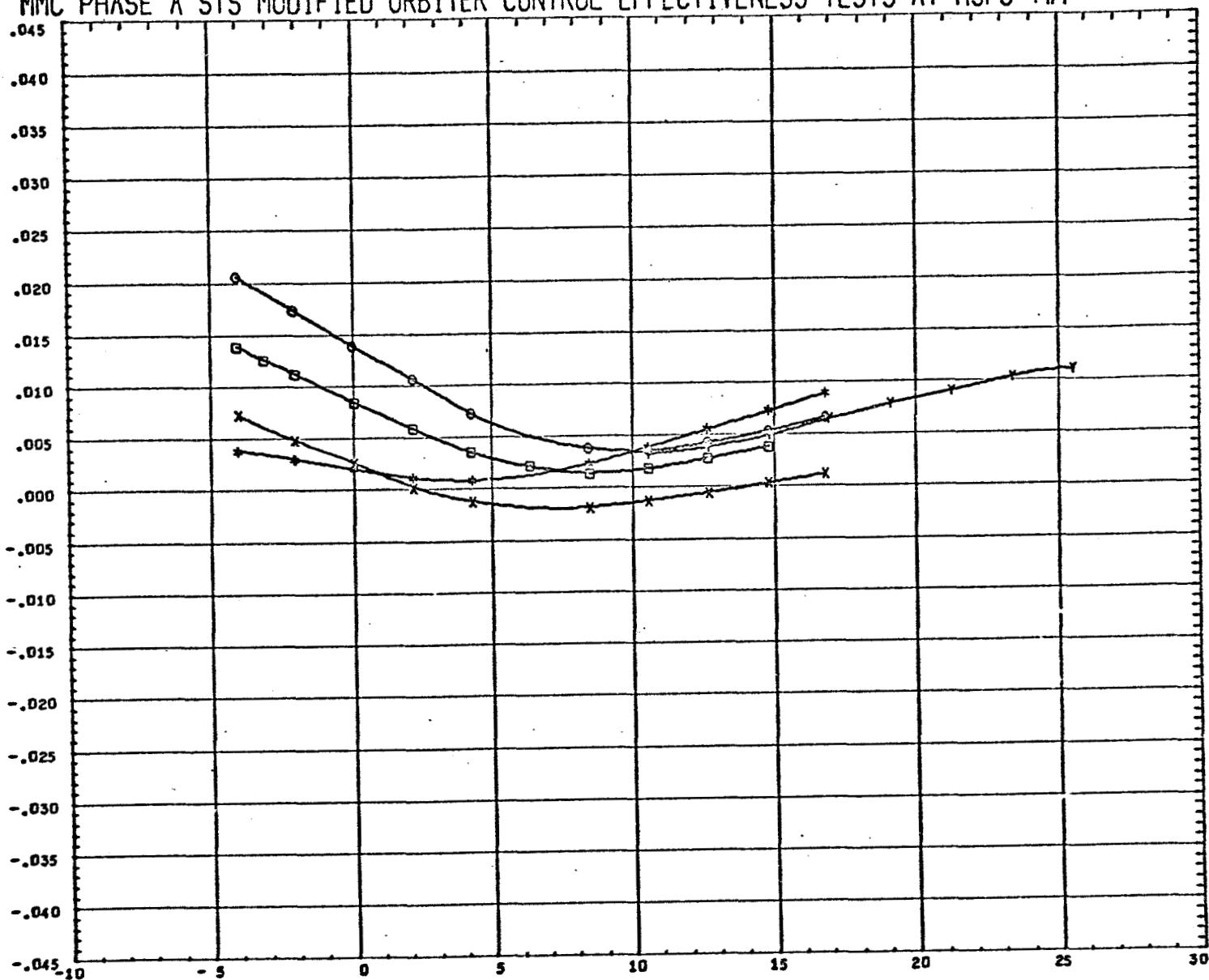
DATA SET DATE MACH NUMBER  
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 (W17025) 06 JUL 70  
 (W17026) 06 JUL 70  
 (W17029) 06 JUL 70

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFb 0.405 FT.  
 XMRF 0.466  
 YMRF 0.500  
 ZMRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CM



ANGLE OF ATTACK, ALPHA DEGREES

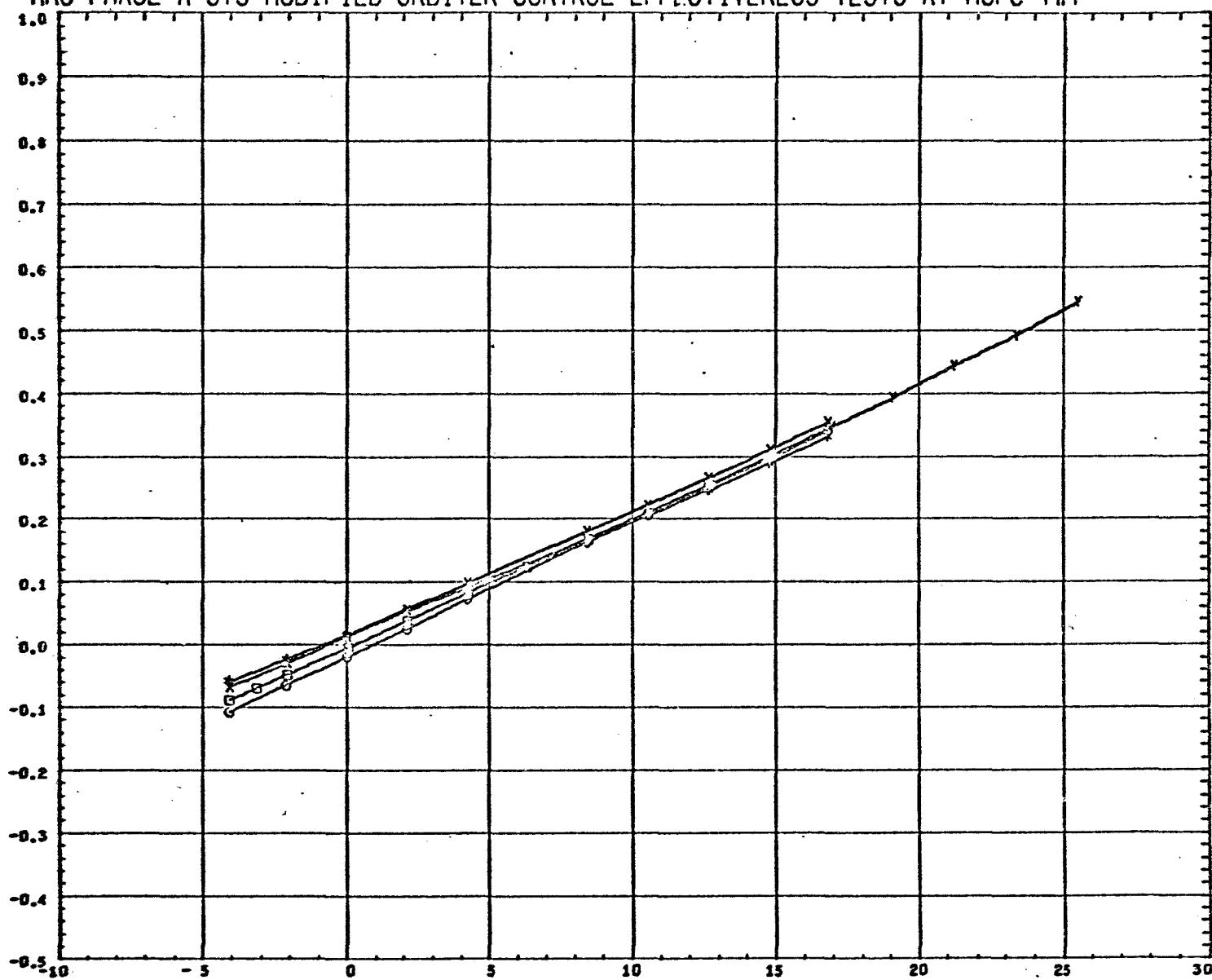
SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(F17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(F17025)	02 JUL 70	REFL 0.646 FT.	
O	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(F17026)	02 JUL 70	REFB 0.405 FT.	
○	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(F17027)	02 JUL 70	XMRP 0.406	
Y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(F17029)	02 JUL 70	YMRP 0.590	
				ZMRP 0.045	

REFERENCE FILE.

PAGE 120

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

NORMAL FORCE COEFFICIENT, CN



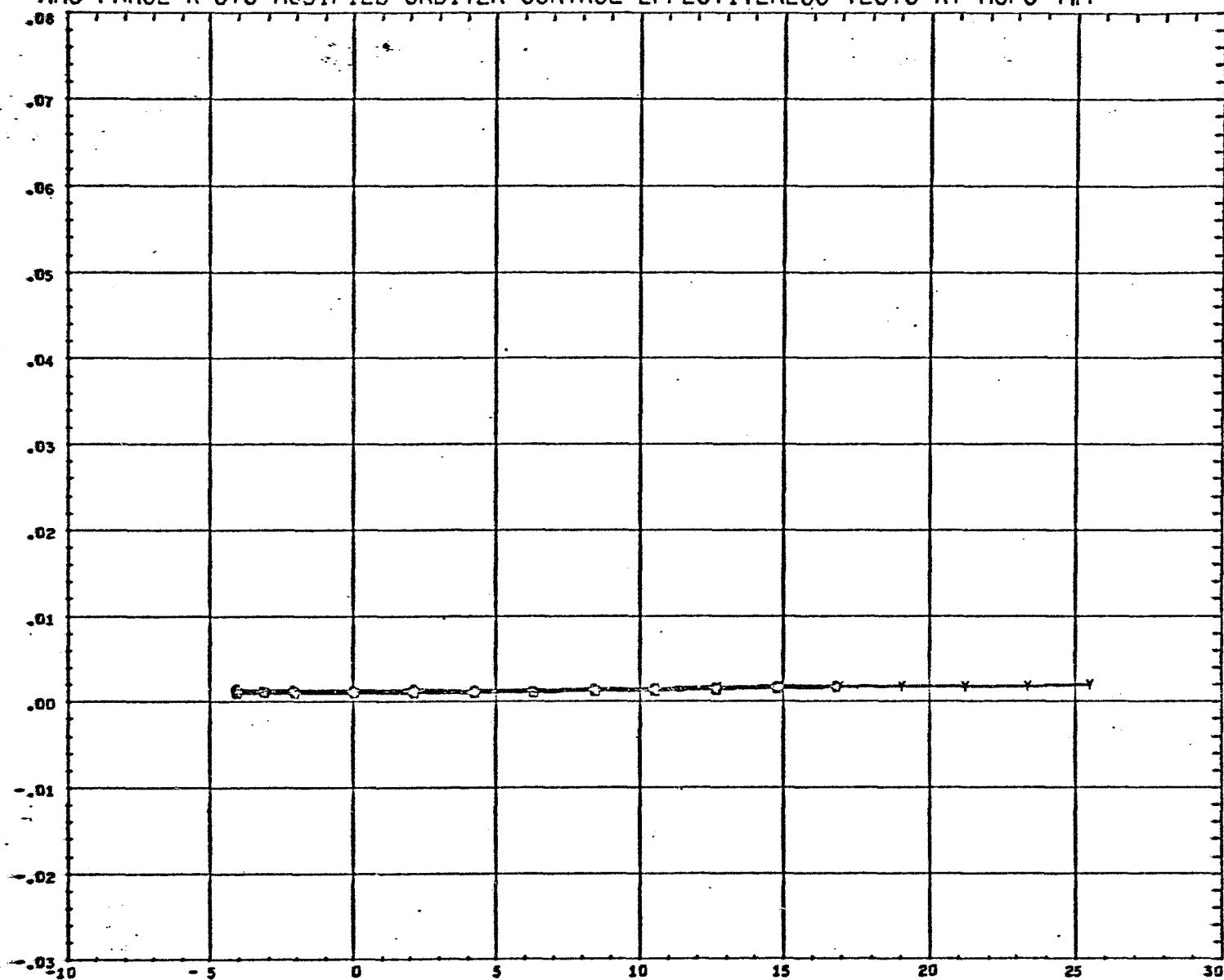
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(F17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(F17025)	02 JUL 70		REFL 0.646 FT.
S	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(F17026)	02 JUL 70		REFB 0.405 FT.
O	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(F17027)	02 JUL 70		XMRP 0.456
T	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(F17029)	02 JUL 70		YMRP 0.050
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT, C<sub>A,BASE</sub>

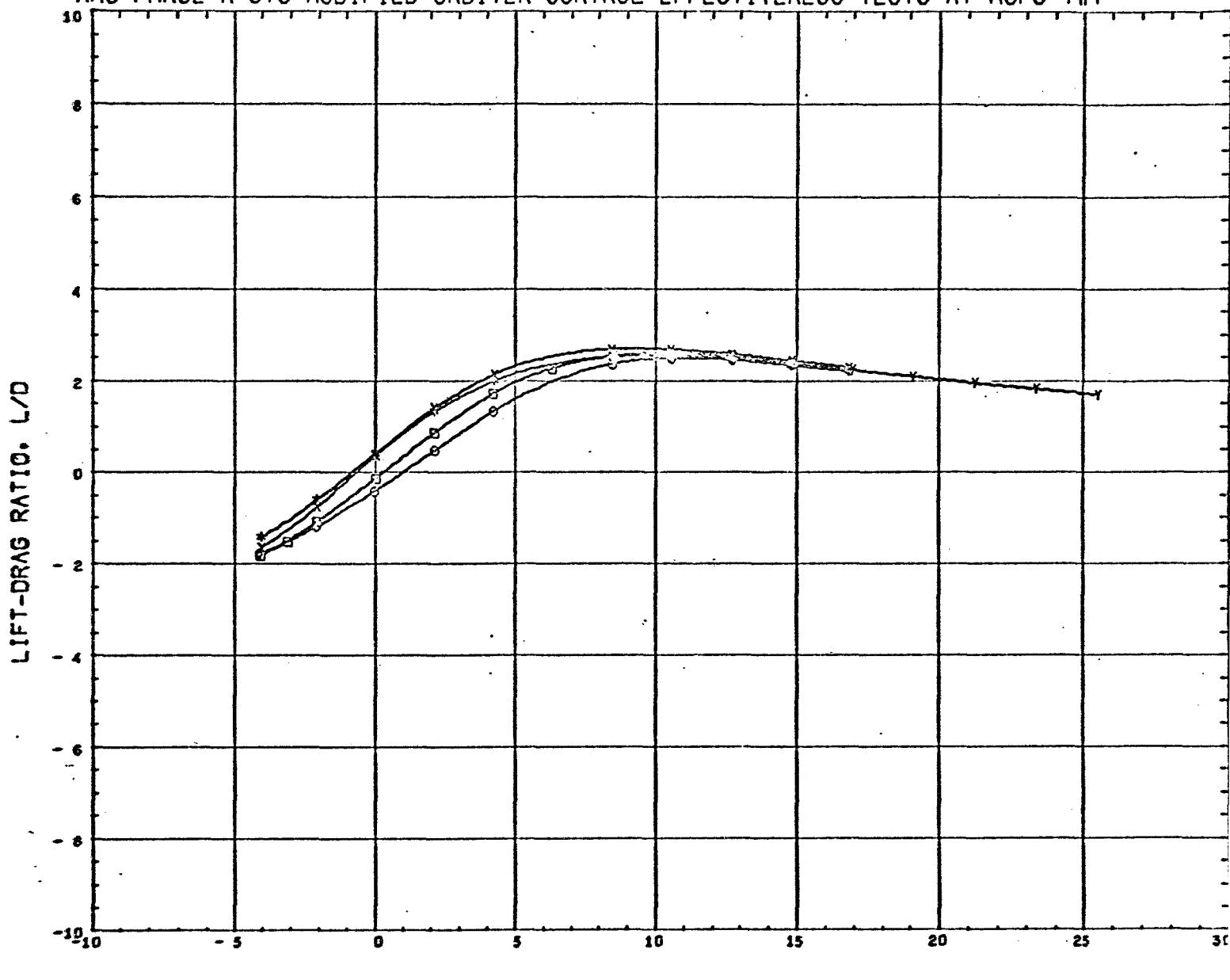


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION		DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1E1R1	E=OFF	(F17024)	02 JUL 70	2.745	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1	E=0	(F17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1	E=-15	(F17026)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1	E=-30	(F17027)	02 JUL 70		XMRP 0.406
Y	MSFC 453 MMC MOD ORB B2W2T1E1R1	E=-30	(F17029)	02 JUL 70		YMRP 0.000
						ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



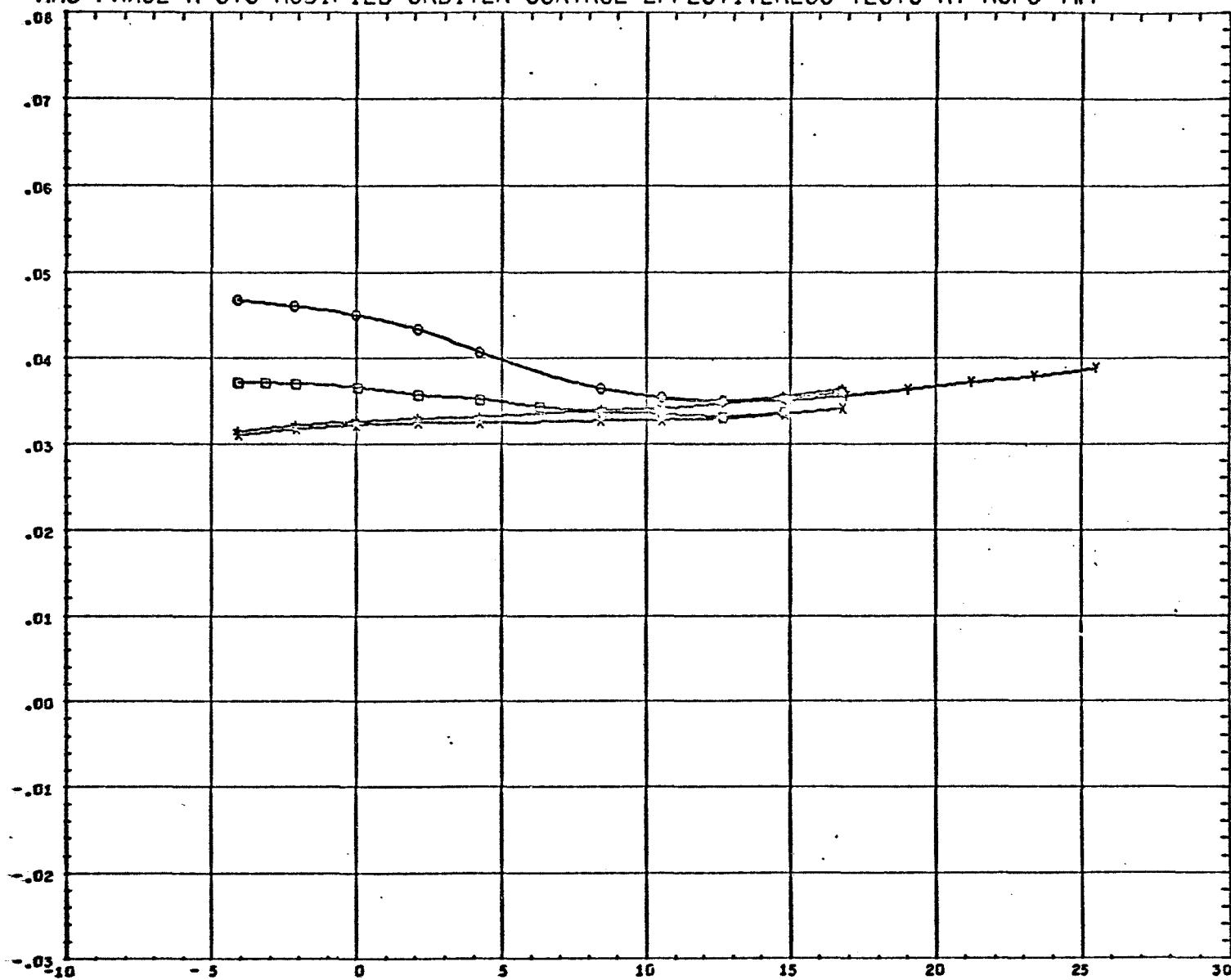
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MCD ORB S2W2T1R1 E=OFF	(F17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MCD ORB S2W2T1E1R1 E=0	(F17025)	02 JUL 70		REFL 0.646 FT.
◻	MSFC 453 MMC MCD ORB S2W2T1E1R1 E=-15	(F17026)	02 JUL 70		REFB 0.405 FT.
○	MSFC 453 MMC MCD ORB S2W2T1E1R1 E=-30	(F17027)	02 JUL 70		XHRF 0.406
▽	MSFC 453 MMC MCD ORB S2W2T1E1R1 E=-35	(F17029)	02 JUL 70		YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAFORE

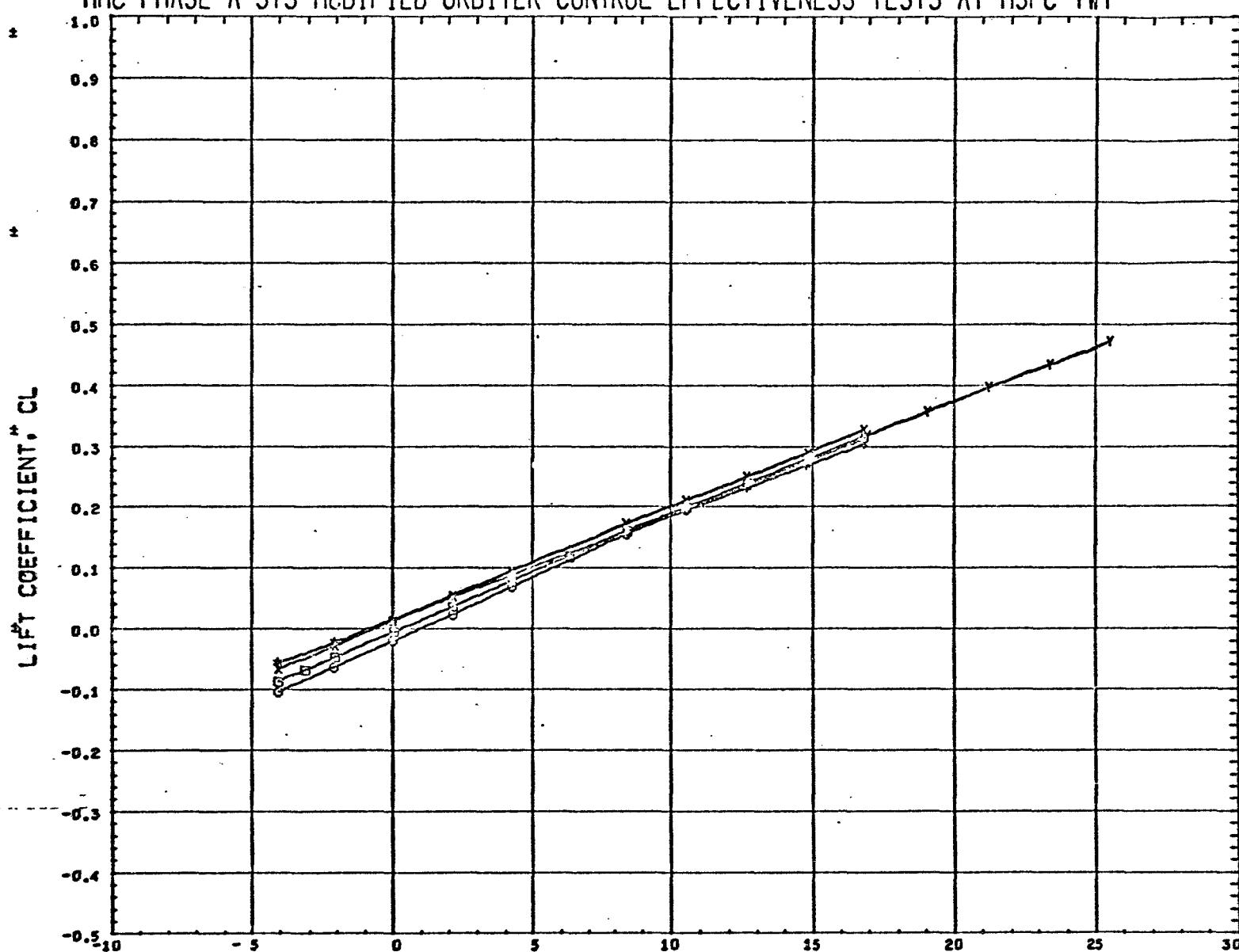


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MCD ORB B2W2T1R1 E=OFF	(F17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=0	(F17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-15	(F17026)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-30	(F17027)	02 JUL 70		XHRF 0.456
Y	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-30	(F17029)	02 JUL 70		YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

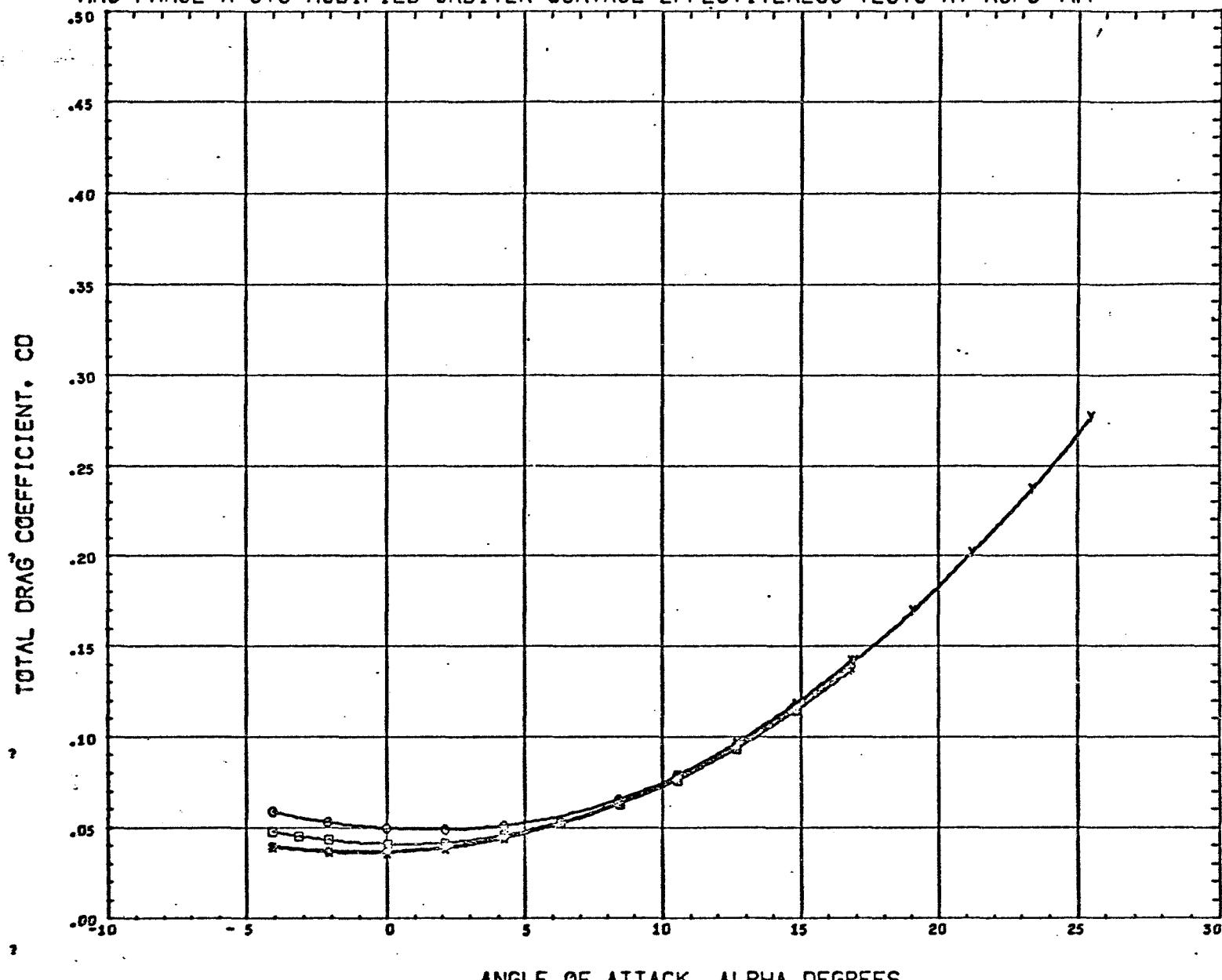


ANGLE OF ATTACK. ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(X17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(X17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(X17026)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(X17027)	02 JUL 70		XHRF 0.406
Y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(X17029)	02 JUL 70		ZHRF 0.000
					0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



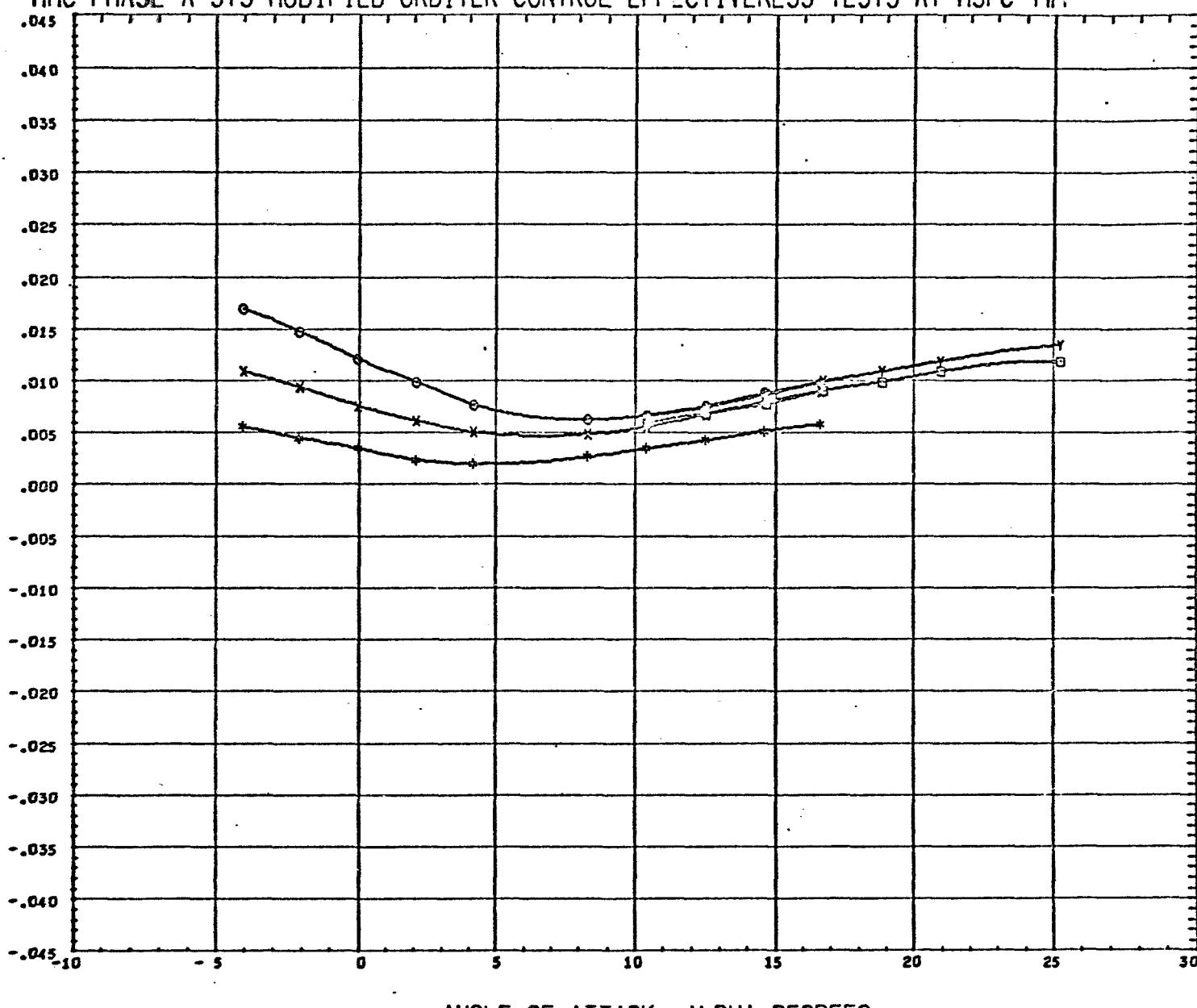
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MCC ORB B2W2T1R1 E=OFF	(X17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MCC ORB B2W2T1E1R1 E=0	(X17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MCC ORB B2W2T1E1R1 E=-15	(X17026)	02 JUL 70		REFB 0.405 FT.
Q	MSFC 453 MMC MCC ORB B2W2T1E1R1 E=-30	(X17027)	02 JUL 70		XHRF 0.406
Y	MSFC 453 MMC MCC ORB B2W2T1E1R1 E=-30	(X17029)	02 JUL 70		YHRF 0.000
					ZKRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM'

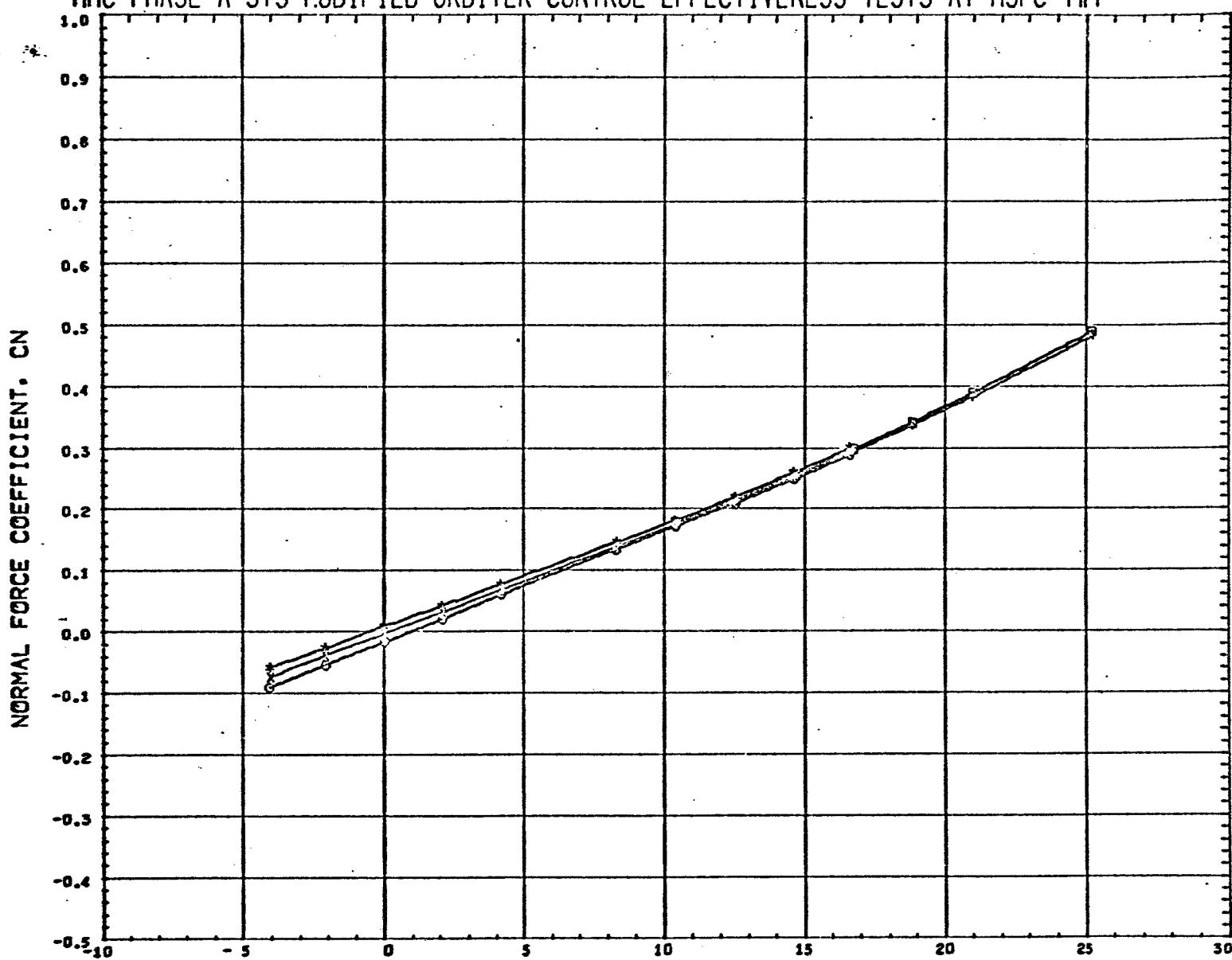


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
\$	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(G17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(G17026)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(G17028)	02 JUL 70		REFB 0.405 FT.
o	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(G17027)	02 JUL 70		XHRF 0.406
y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(G17029)	02 JUL 70		YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



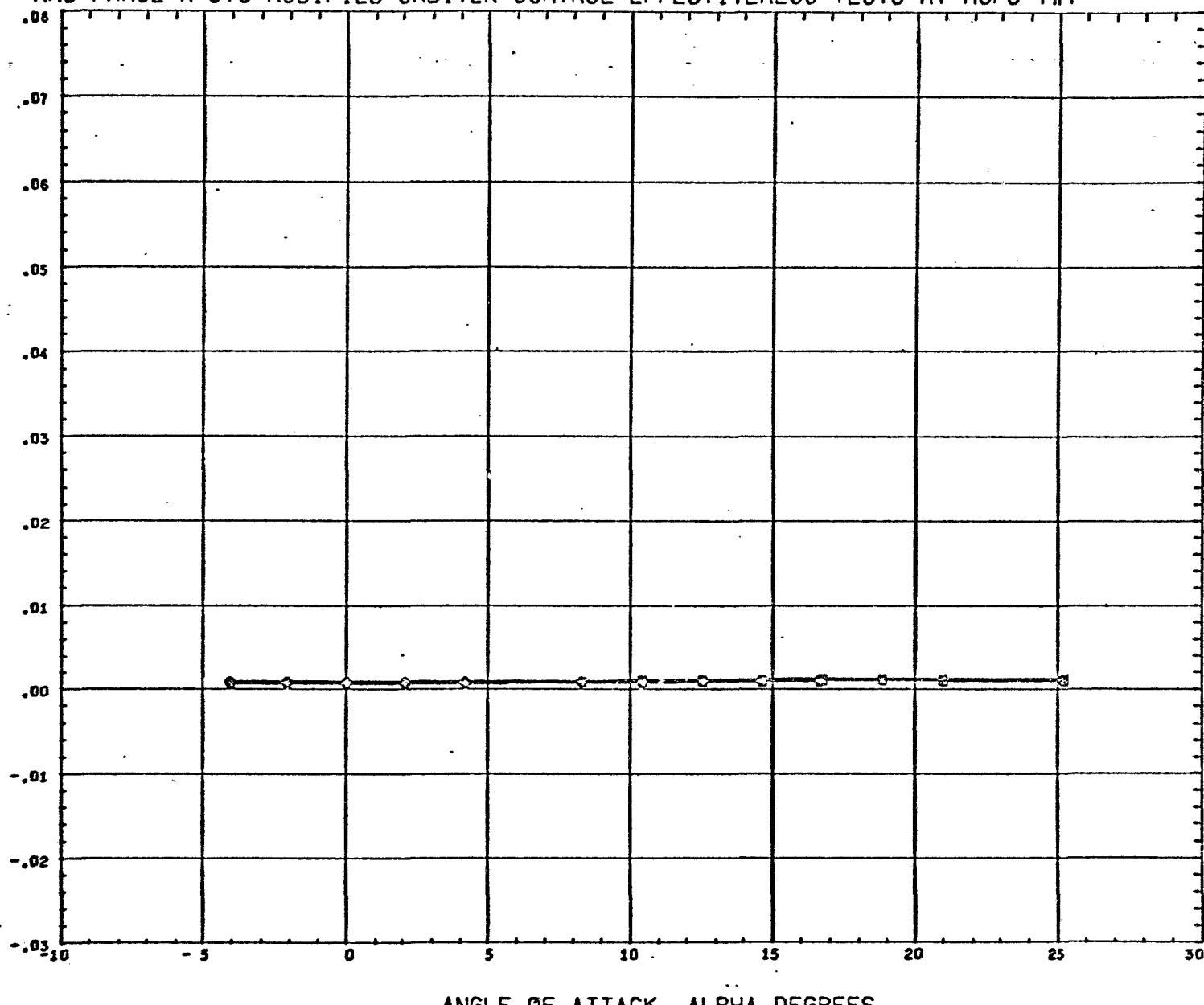
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(G17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(G17026)	02 JUL 70		REFL 0.646 FT.
O	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(G17028)	02 JUL 70		REFB 0.405 FT.
o	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(G17027)	02 JUL 70		XHRF 0.456
v	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(G17029)	02 JUL 70		YHRF 0.500
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE AXIAL FORCE COEFFICIENT,  $C_{ABASE}$



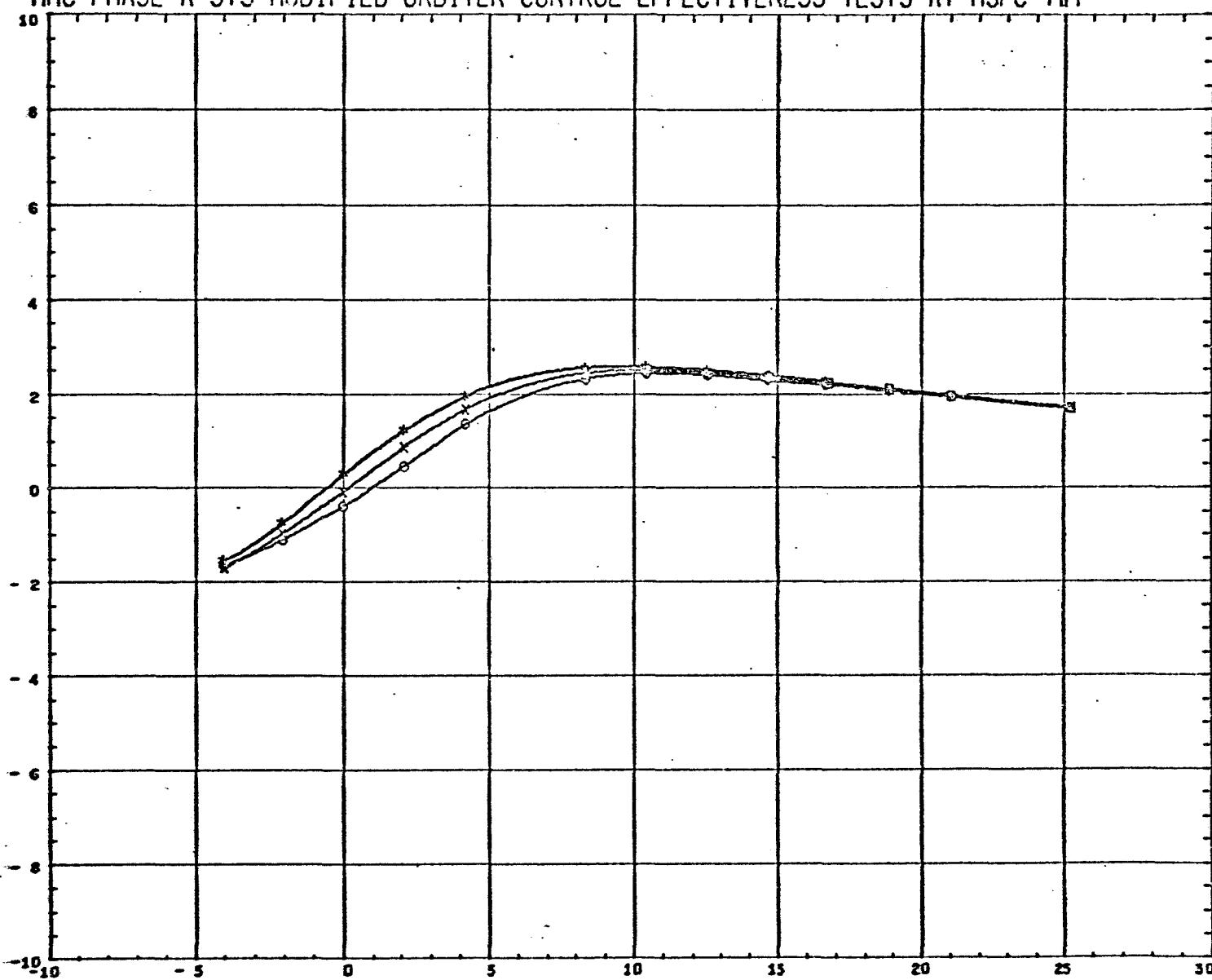
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE	INFORMATION
*	MSFC 453 MMC MOD CR3 B2W2T1E1R1 E=0	(G17025)	02 JUL 70	3.479	REFS	0.116 SQ.FT.
X	MSFC 453 MMC MOD CR3 B2W2T1E1R1 E=-15	(G17026)	02 JUL 70		REFL	0.646 FT.
G	MSFC 453 MMC MOD CR3 B2W2T1E1R1 E=-15	(G17028)	02 JUL 70		REFB	0.405 FT.
G	MSFC 453 MMC MOD CR3 B2W2T1E1R1 E=-30	(G17027)	02 JUL 70		XMRF	0.406
Y	MSFC 453 MMC MOD CR3 B2W2T1E1R1 E=-30	(G17029)	02 JUL 70		YMRF	0.600
					ZMRF	0.645

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

LIFT-DRAG RATIO, L/D



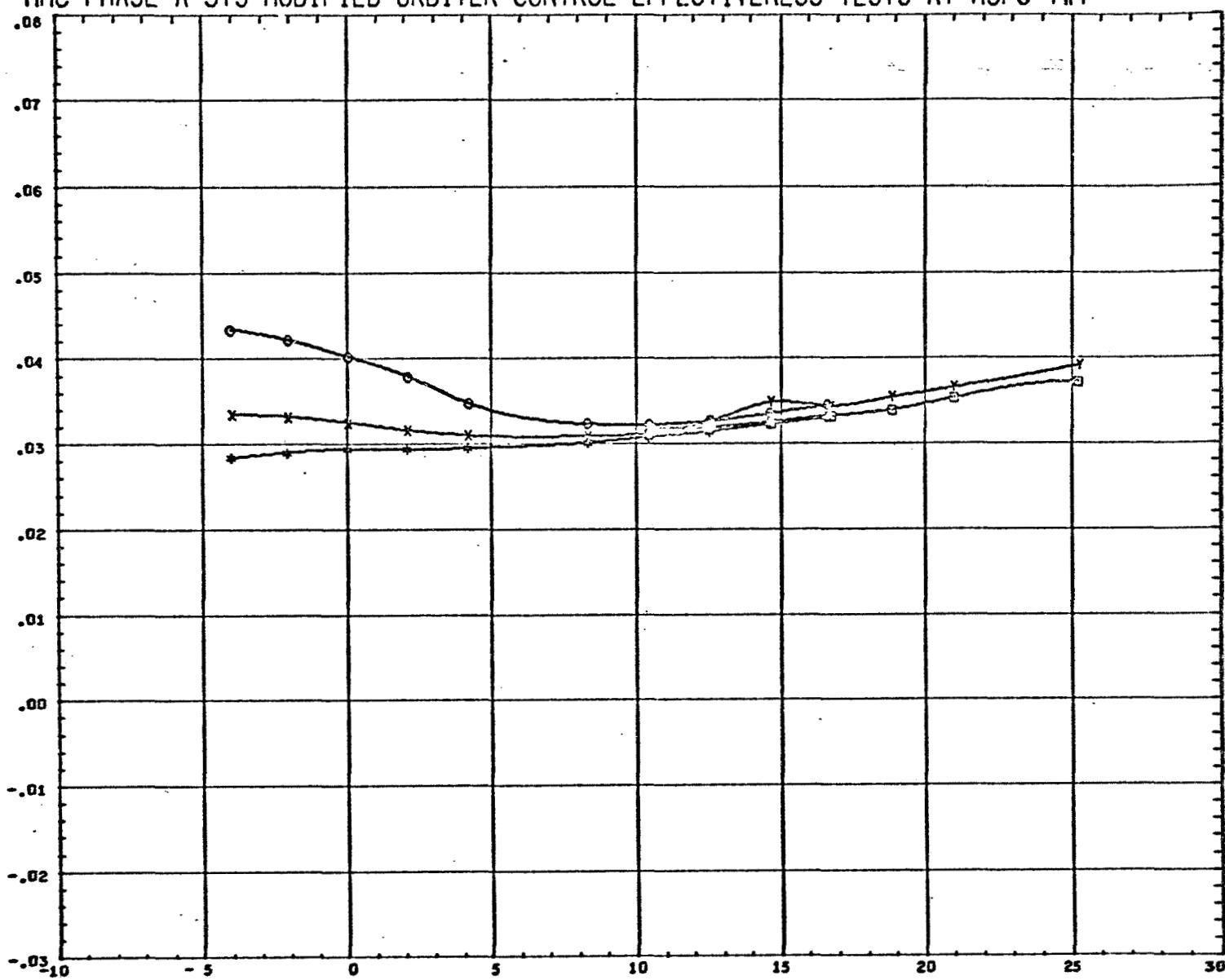
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOC CRB B2W2TIE1R1 E=0	(G17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOC CRB B2W2TIE1R1 E=-15	(G17026)	02 JUL 70		REFL 0.646 FT.
o	MSFC 453 MMC MOC CRB B2W2TIE1R1 E=-15	(G17028)	02 JUL 70		REFB 0.495 FT.
v	MSFC 453 MMC MOC CRB B2W2TIE1R1 E=-30	(G17027)	02 JUL 70		XMRF 0.496
		(G17029)	02 JUL 70		YHRF 0.099
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAF0RE

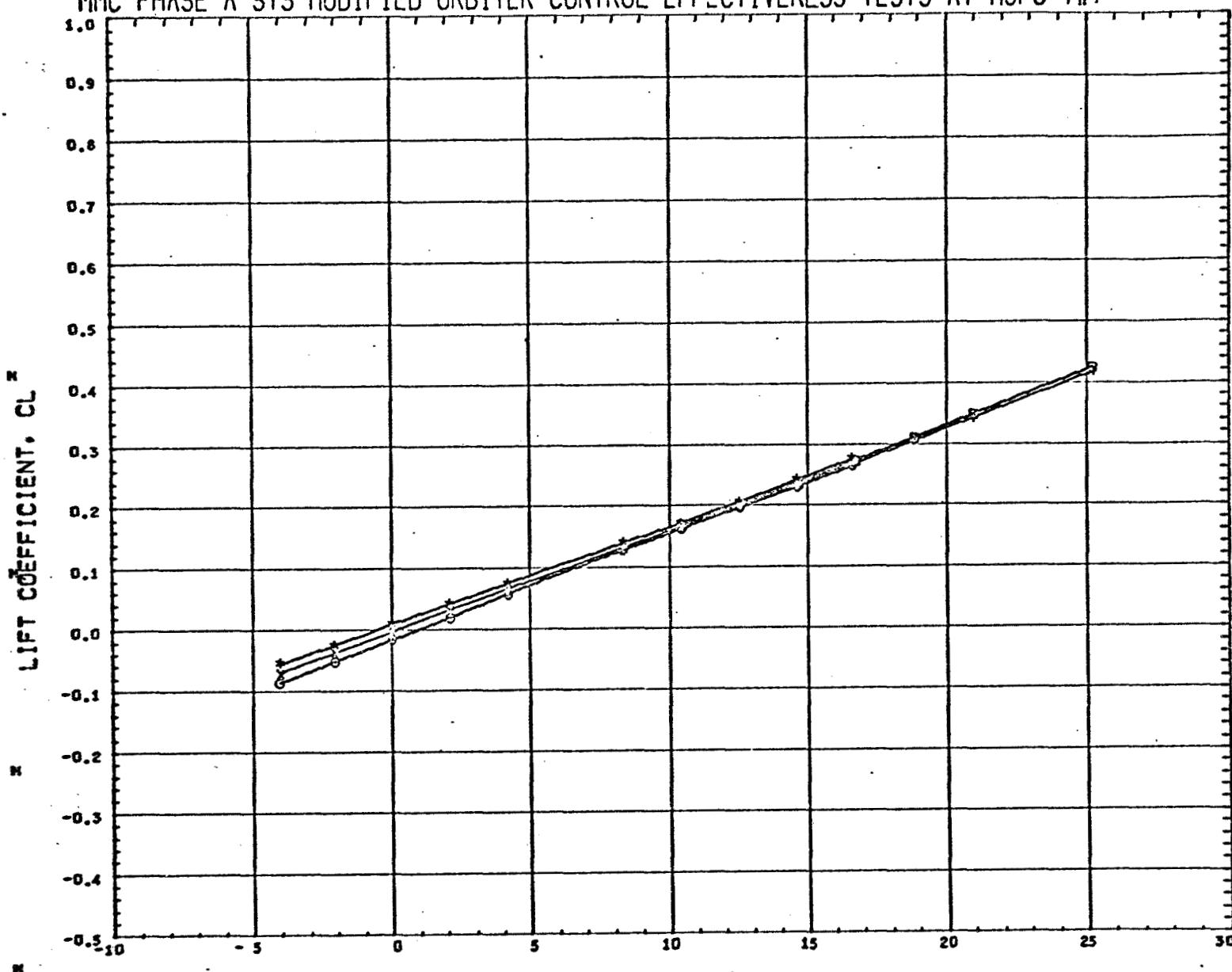


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=0	(G17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
x	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-15	(G17026)	02 JUL 70		REFL 0.646 FT.
o	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-15	(G17028)	02 JUL 70		REFB 0.405 FT.
o	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-30	(G17027)	02 JUL 70		XHRF 0.456
*	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-30	(G17029)	02 JUL 70		YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



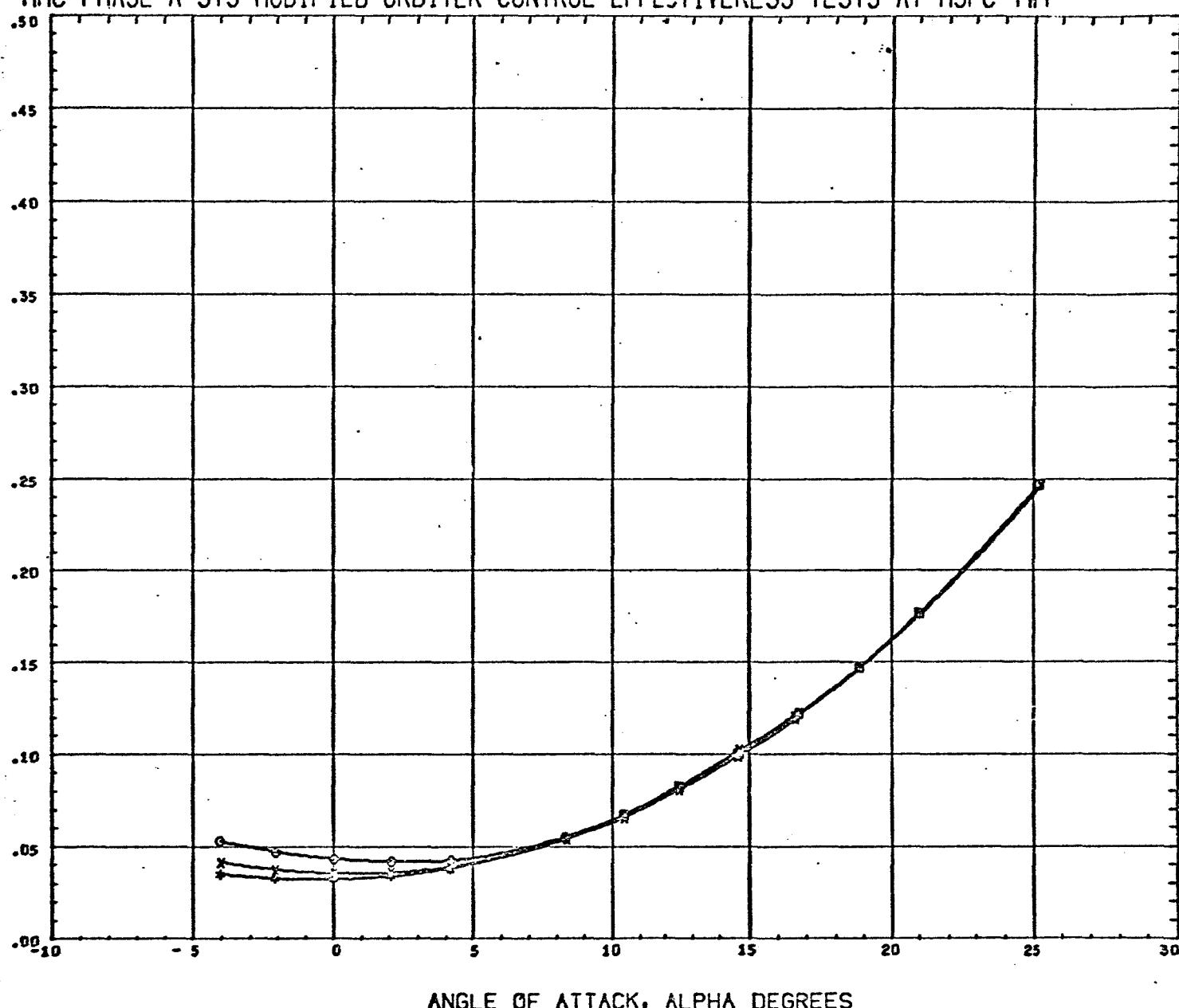
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MGD ORB B2W2T1E1R1 E=0	(Y17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MGD ORB B2W2T1E1R1 E=-15	(Y17026)	02 JUL 70		REFL 0.646 FT.
o	MSFC 453 MMC MGD ORB B2W2T1E1R1 E=-15	(Y17028)	02 JUL 70		REFB 0.405 FT.
o	MSFC 453 MMC MGD ORB B2W2T1E1R1 E=-30	(Y17027)	02 JUL 70		XHRF 0.456
y	MSFC 453 MMC MGD ORB B2W2T1E1R1 E=-30	(Y17029)	02 JUL 70		YMRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT, CD



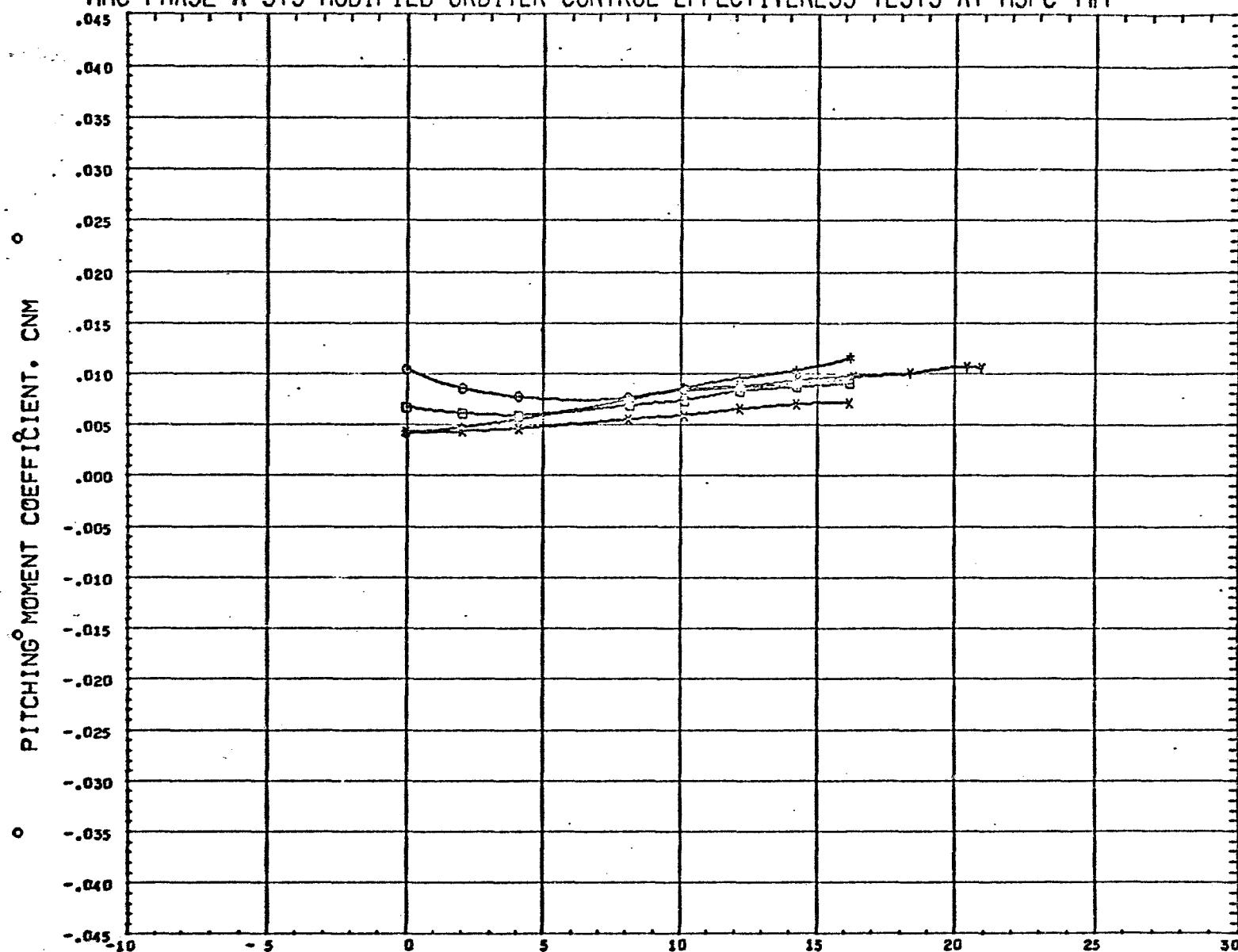
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MHC MCC ORB E2W2T1E1R1 E=0	(Y17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
X	MSFC 453 MHC MCC ORB E2W2T1E1R1 E=-15	(Y17026)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MHC MCC ORB E2W2T1E1R1 E=-15	(Y17028)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MHC MCC ORB E2W2T1E1R1 E=-30	(Y17027)	02 JUL 70		XMRP 0.406
Y	MSFC 453 MHC MCC ORB E2W2T1E1R1 E=-30	(Y17029)	02 JUL 70		YMRP 0.500
					ZMRP 0.545

REFERENCE FILE.

PAGE 133

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



ANGLE OF ATTACK, ALPHA DEGREES

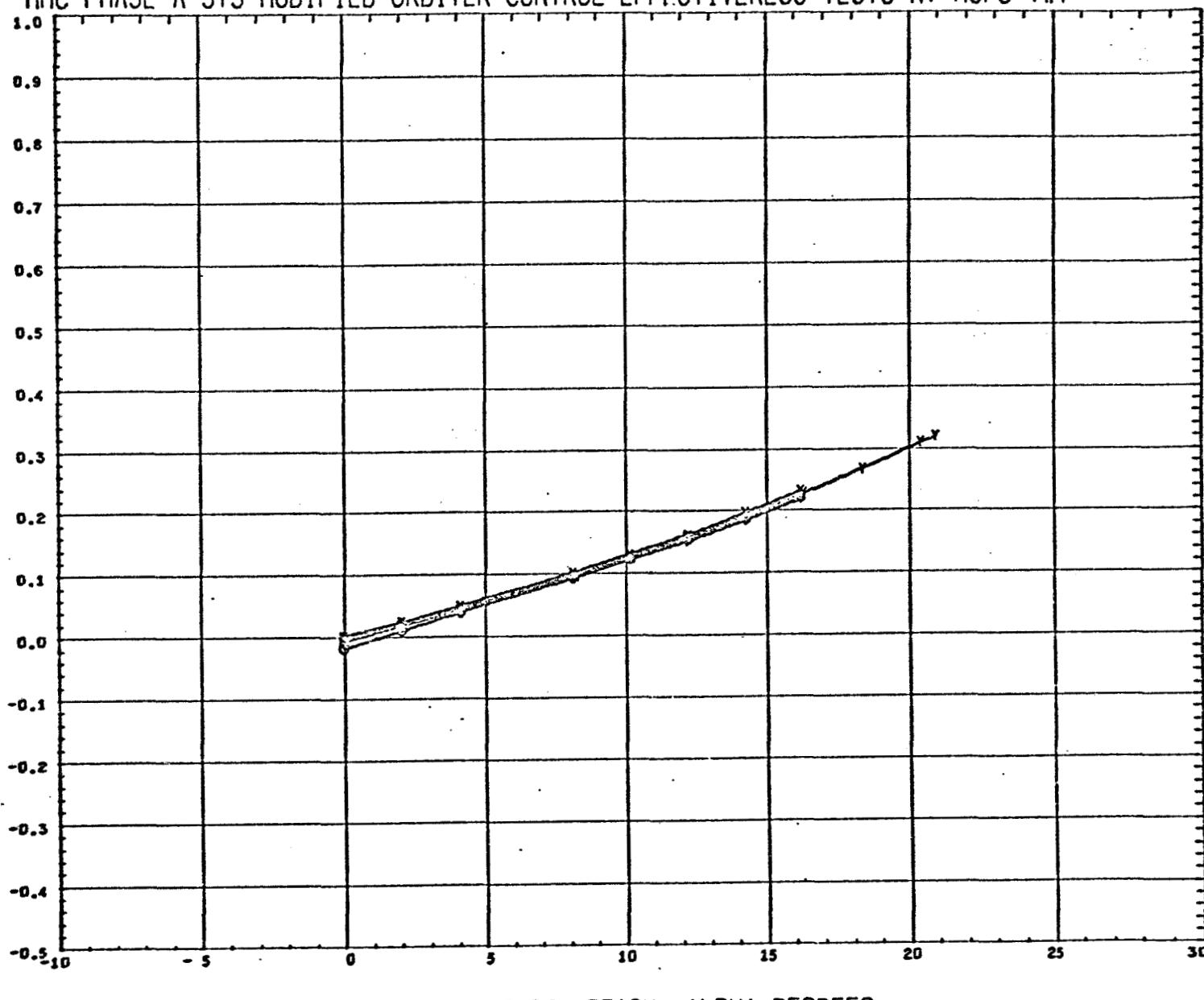
SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MMC MOG ORB B2W2T1R1 E=OFF
X	MSFC 453 MMC MOG ORB B2W2T1E1R1 E=0
G	MSFC 453 MMC MOG ORB B2W2T1E1R1 E=-15
O	MSFC 453 MMC MOG ORB B2W2T1E1R1 E=-30
Y	MSFC 453 MMC MOG ORB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(H17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
(H17025)	02 JUL 70		REFL 0.646 FT.
(H17026)	02 JUL 70		REFB 0.405 FT.
(H17027)	02 JUL 70		XMRF 0.406
(H17029)	02 JUL 70		YMRF 0.000
			ZMRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

NORMAL FORCE COEFFICIENT, CN



ANGLE OF ATTACK, ALPHA DEGREES

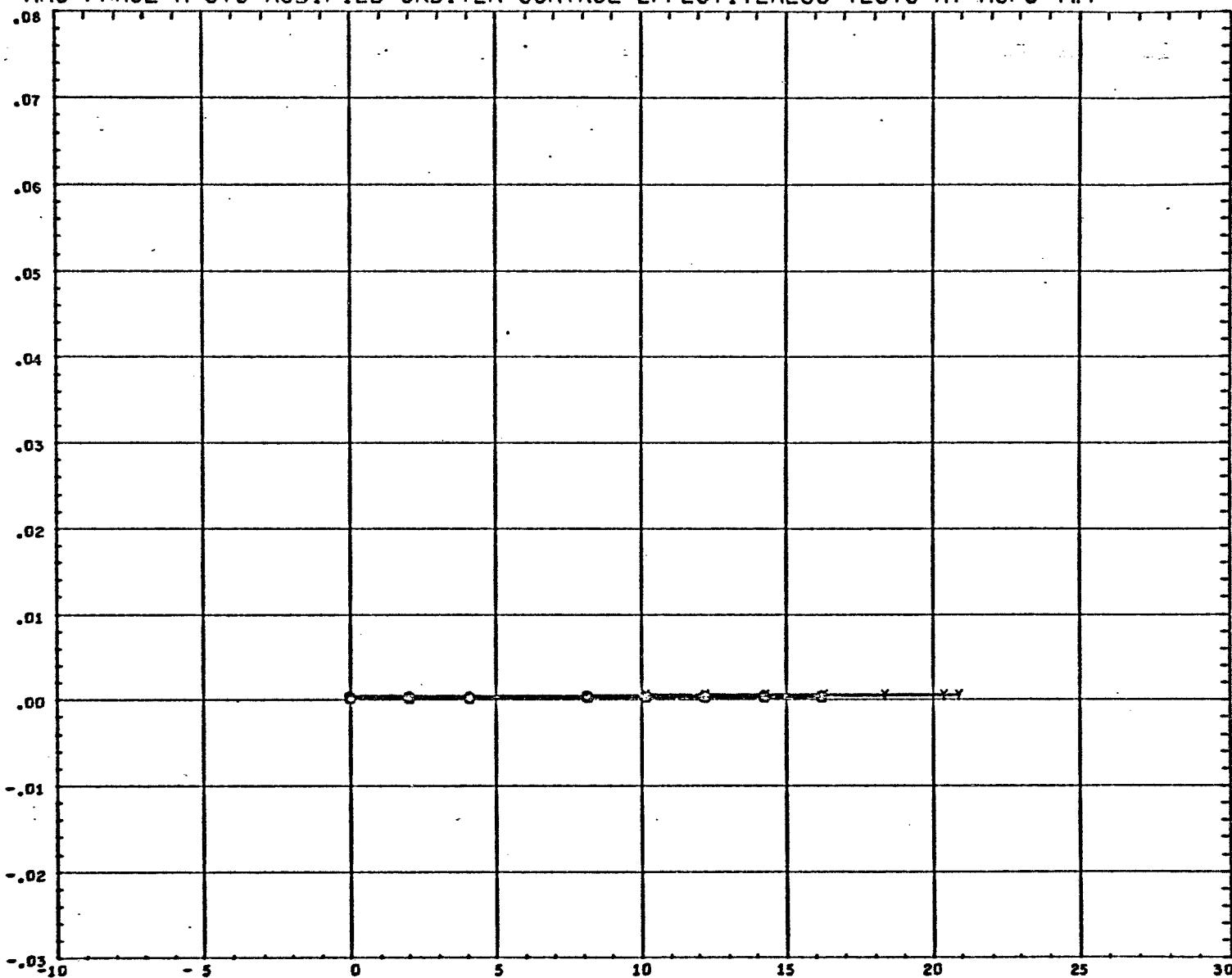
SYMBOL	CONFIGURATION DESCRIPTION		DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MHC MOD ORB B2W2T1R1	E=OFF	(H17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
x	MSFC 453 MHC MOD ORB B2W2T1E1R1	E=0	(H17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MHC MOD ORB B2W2T1E1R1	E=-15	(H17026)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MHC MOD ORB B2W2T1E1R1	E=-30	(H17027)	02 JUL 70		XMRF 0.406
v	MSFC 453 MHC MOD ORB B2W2T1E1R1	E=-30	(H17029)	02 JUL 70		YHRF 0.000
						ZMRF 0.045

REFERENCE FILE.

PAGE 135

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

BASE<sup>a</sup> AXIAL FORCE COEFFICIENT, C<sub>A,BASE</sub>



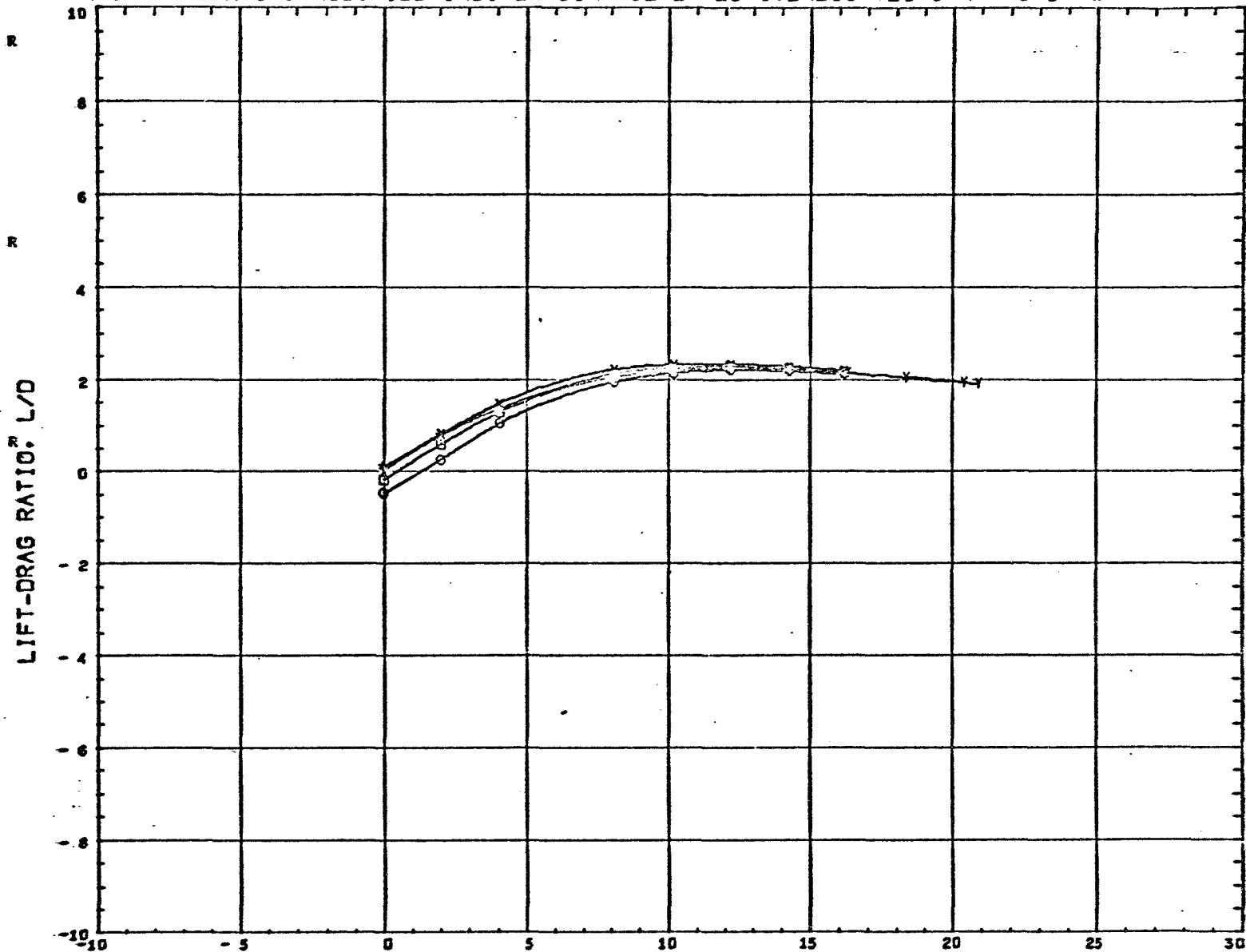
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MMC MCD CRB B2W2T1R1 E=OFF
X	MSFC 453 MMC MCD CRB B2W2T1E1R1 E=0
□	MSFC 453 MMC MCD CRB B2W2T1E1R1 E=-15
G	MSFC 453 MMC MCD CRB B2W2T1E1R1 E=-30
V	MSFC 453 MMC MCD CRB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(H17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
(H17025)	02 JUL 70		REFL 0.646 FT.
(H17026)	02 JUL 70		REFB 0.405 FT.
(H17027)	02 JUL 70		XMRP 0.406
(H17029)	02 JUL 70		YMRP 0.999
			ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



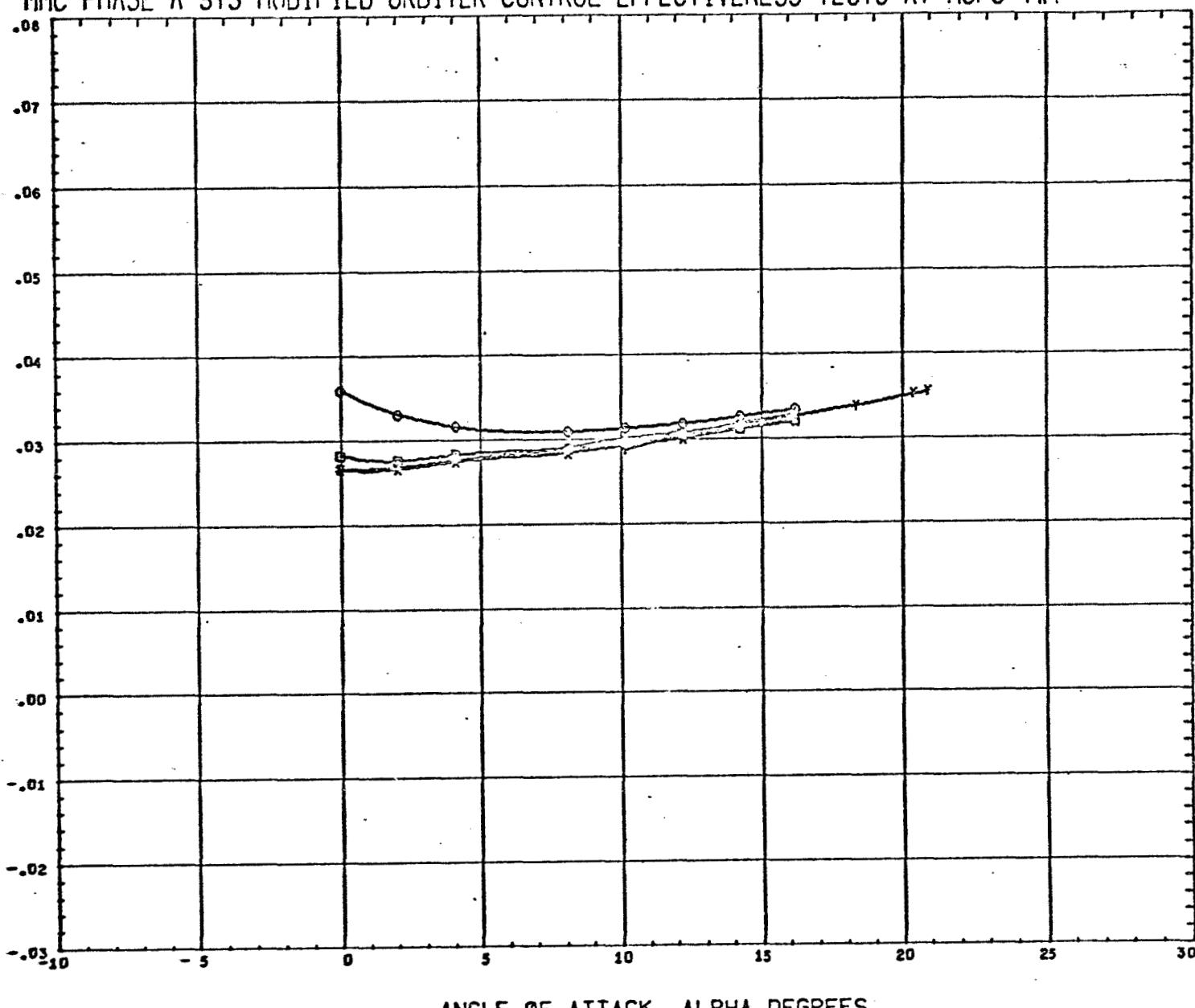
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
●	MSFC 453 MMC MCD ORB B2W2T1R1 E=OFF	(H17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=0	(H17025)	02 JUL 70		REFL 0.646 FT.
○	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-15	(H17026)	02 JUL 70		REFB 0.405 FT.
*	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-30	(H17027)	02 JUL 70		XMRF 0.406
Y	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-30	(H17029)	02 JUL 70		YMRF 0.000
					ZMRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

FOREBODY AXIAL FORCE COEFFICIENT, CAFOR

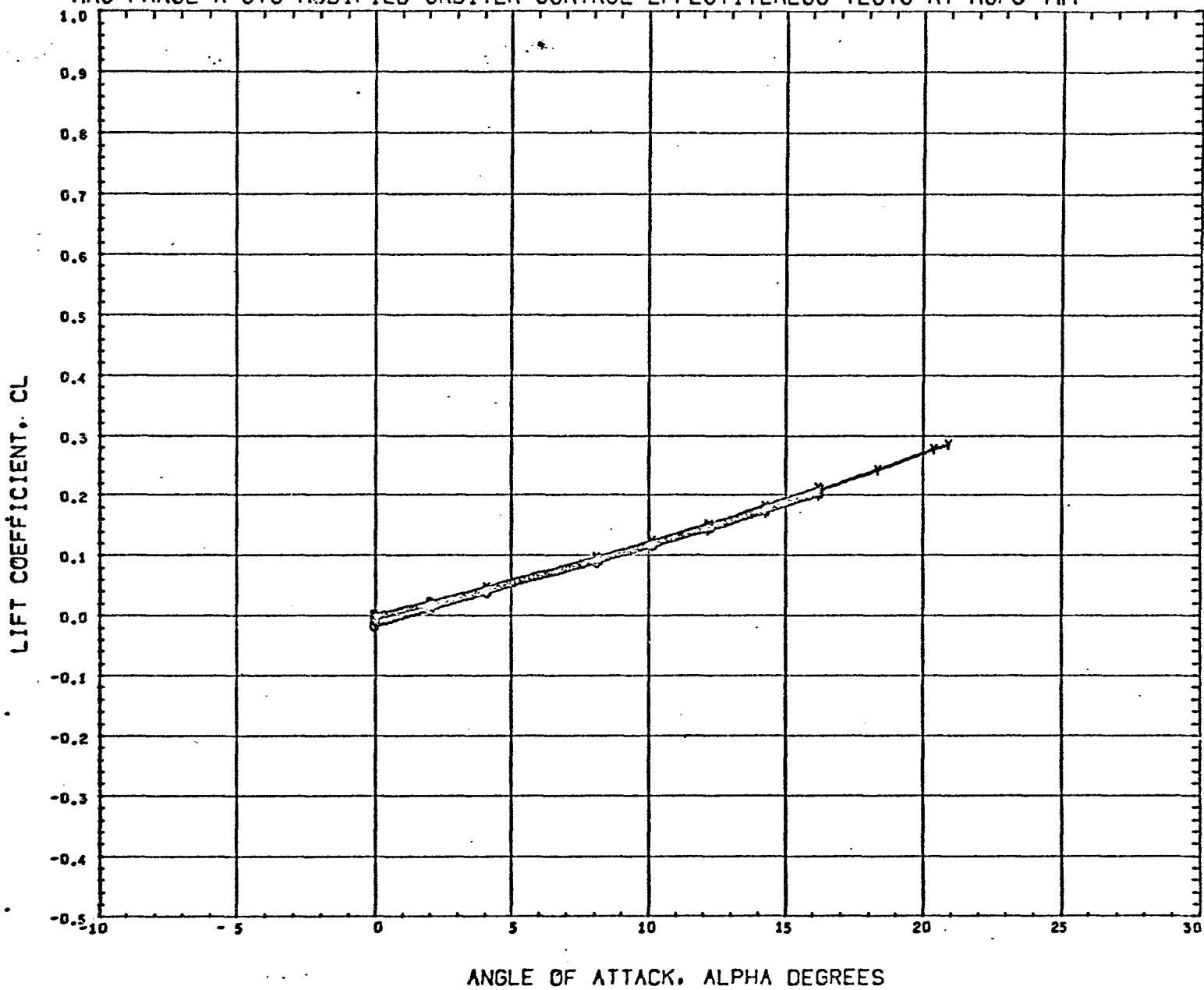


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MHC MCD ORB B2W2T1R1 E=OFF	(H17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
X	MSFC 453 MHC MCD ORB B2W2T1E1R1 E=0	(H17025)	02 JUL 70		REFL 0.646 FT.
S	MSFC 453 MHC MCD ORB B2W2T1E1R1 E=-15	(H17026)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MHC MCD ORB B2W2T1E1R1 E=-30	(H17027)	02 JUL 70		XHRF 0.436
V	MSFC 453 MHC MCD ORB B2W2T1E1R1 E=-30	(H17029)	02 JUL 70		YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



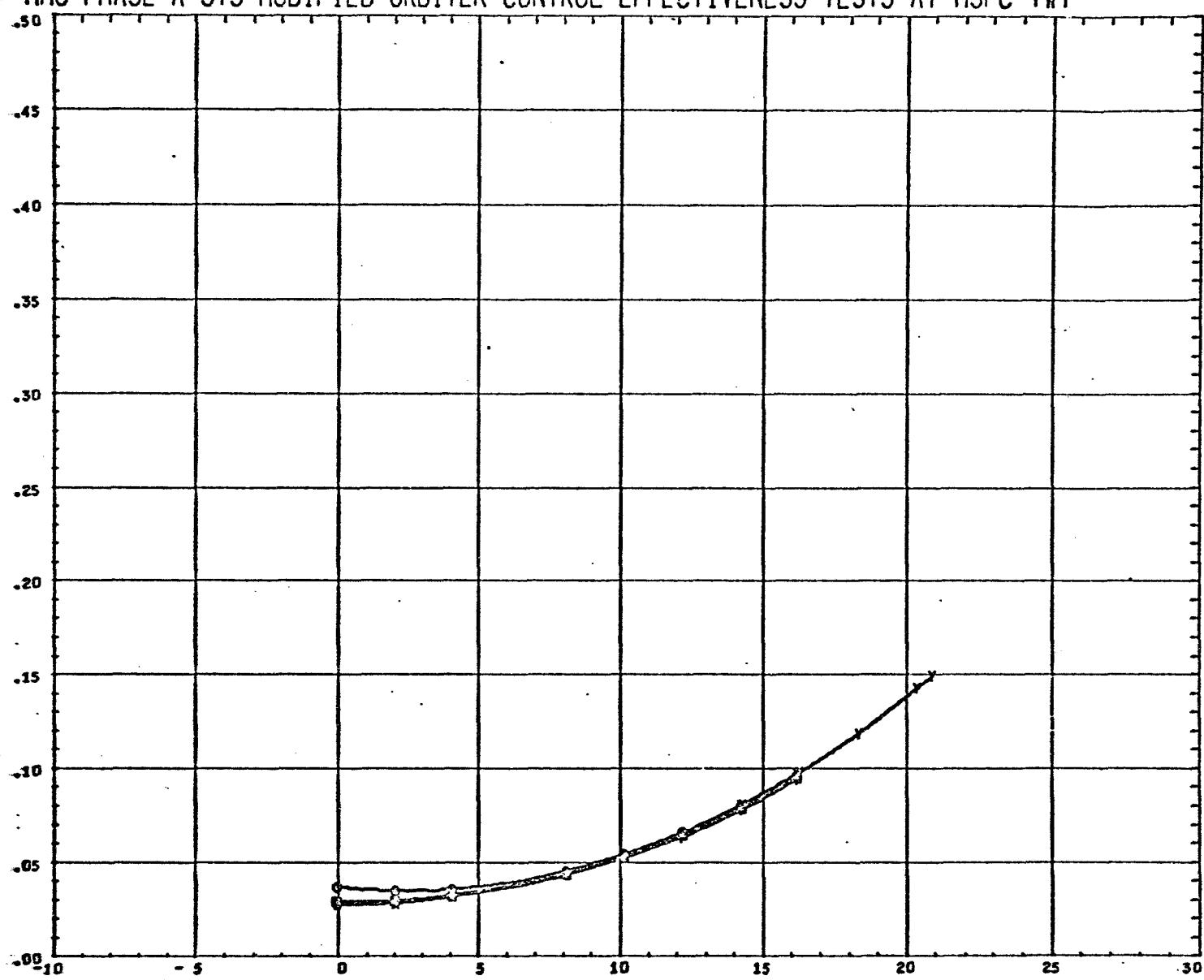
ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MHC MOD ORB B2W2T1R1 E=OFF	(Z17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
X	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=0	(Z17025)	02 JUL 70		REFL 0.646 FT.
O	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-15	(Z17026)	02 JUL 70		REFB 0.405 FT.
O	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-30	(Z17027)	02 JUL 70		XHRF 0.406
Y	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-30	(Z17029)	02 JUL 70		YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

TOTAL DRAG COEFFICIENT, CD

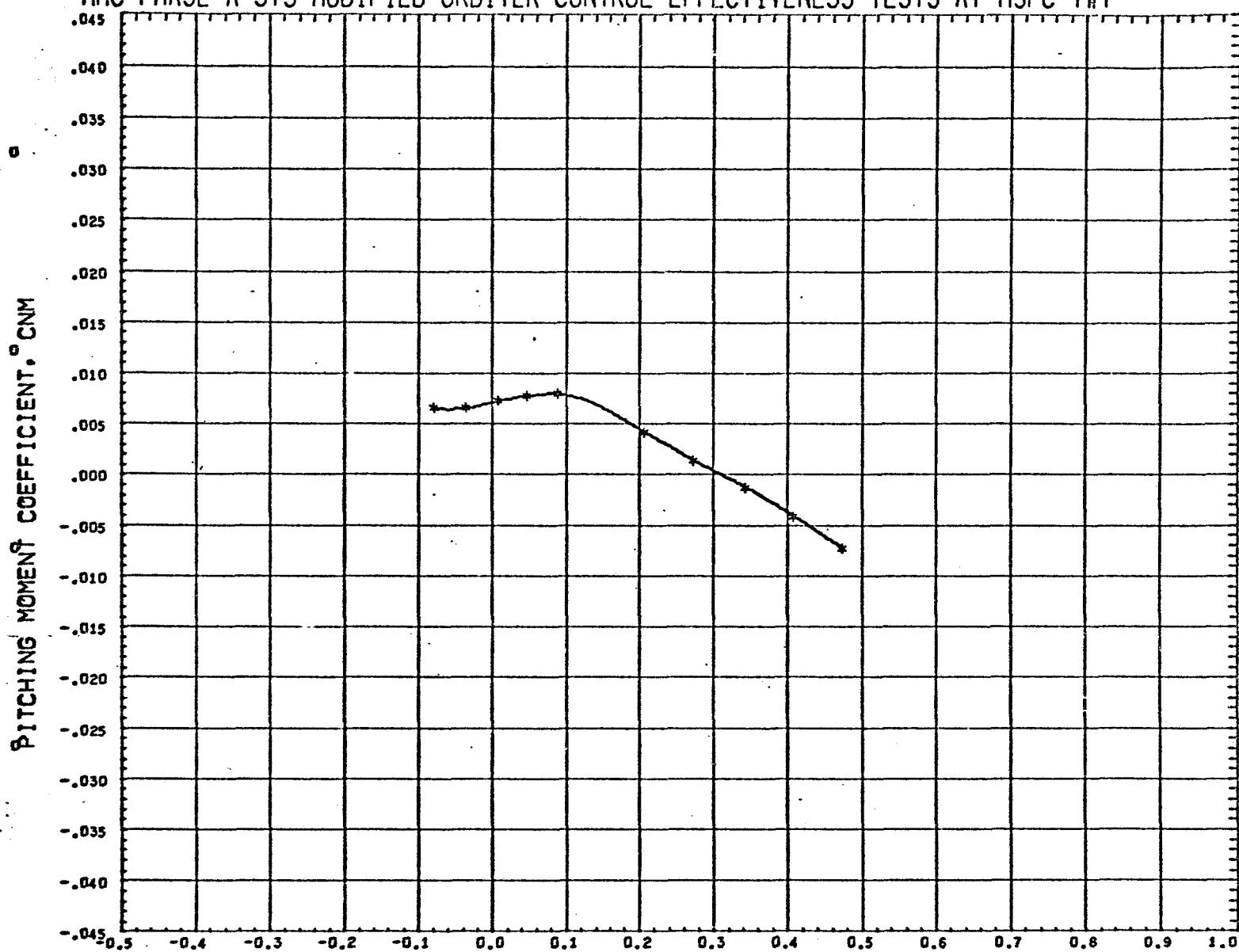


ANGLE OF ATTACK, ALPHA DEGREES

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2TIE1 E=OFF	(Z17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOD ORB B2W2TIE1RI E=0	(Z17025)	02 JUL 70		REFL 0.645 FT.
o	MSFC 453 MMC MOD ORB B2W2TIE1RI E=-15	(Z17026)	02 JUL 70		REFB 0.405 FT.
o	MSFC 453 MMC MOD ORB B2W2TIE1RI E=-30	(Z17027)	02 JUL 70		XMRP 0.406
t	MSFC 453 MMC MOD ORB B2W2TIE1RI E=-30	(Z17029)	02 JUL 70		YMRP 0.000
					ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



NORMAL FORCE COEFFICIENT, CN

SYMBOL MACH PARAMETRIC VALUES  
 ● 0.396 BETA 9,000 ELEVON 0,000

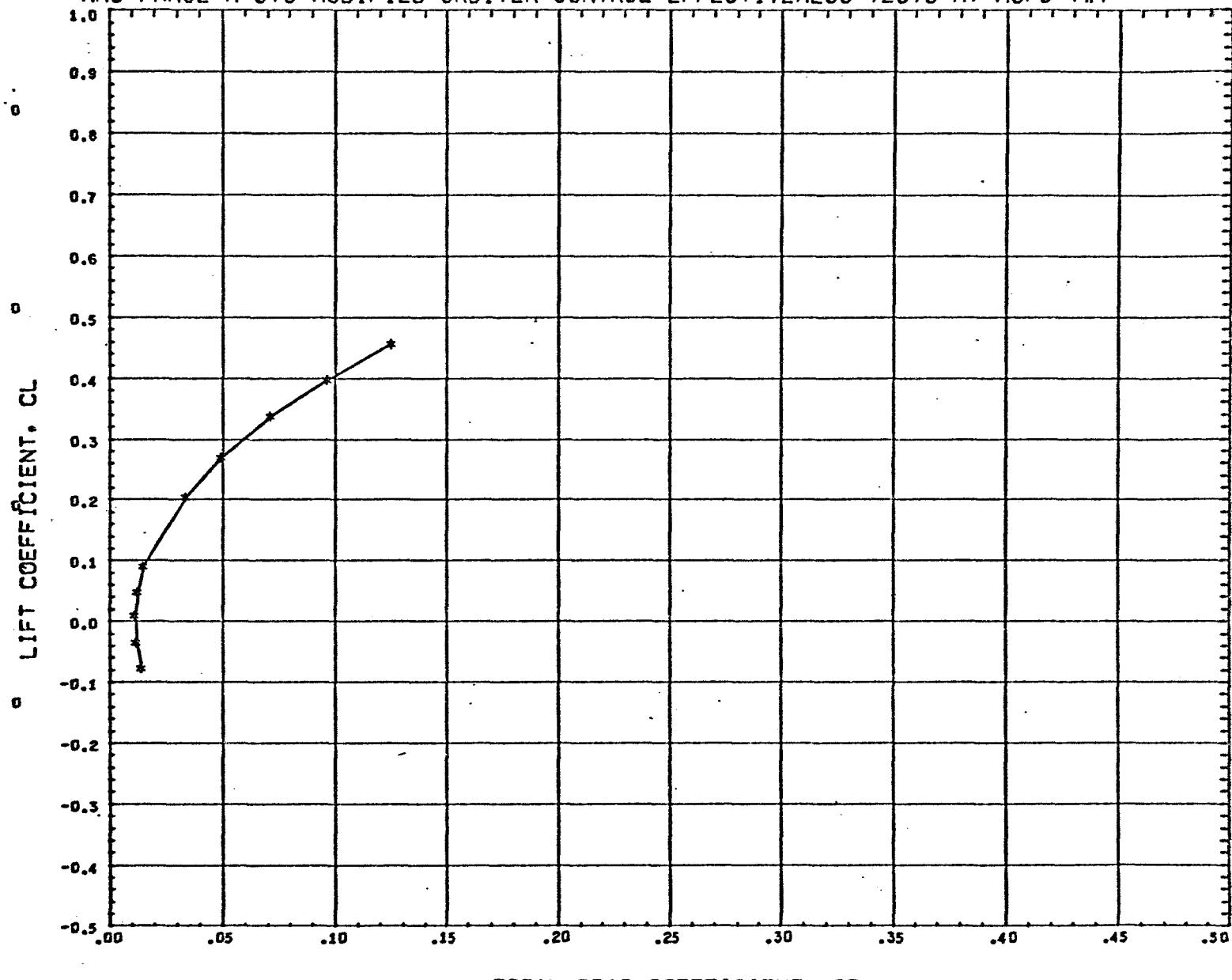
REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRF	0.045	

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E0

[R17021] 02 JUL 70 PAGE 141

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT, CD

SYMBOL MACH PARAMETRIC VALUES  
 \* 0.396 BETA 0.000 ELEVON 0.000

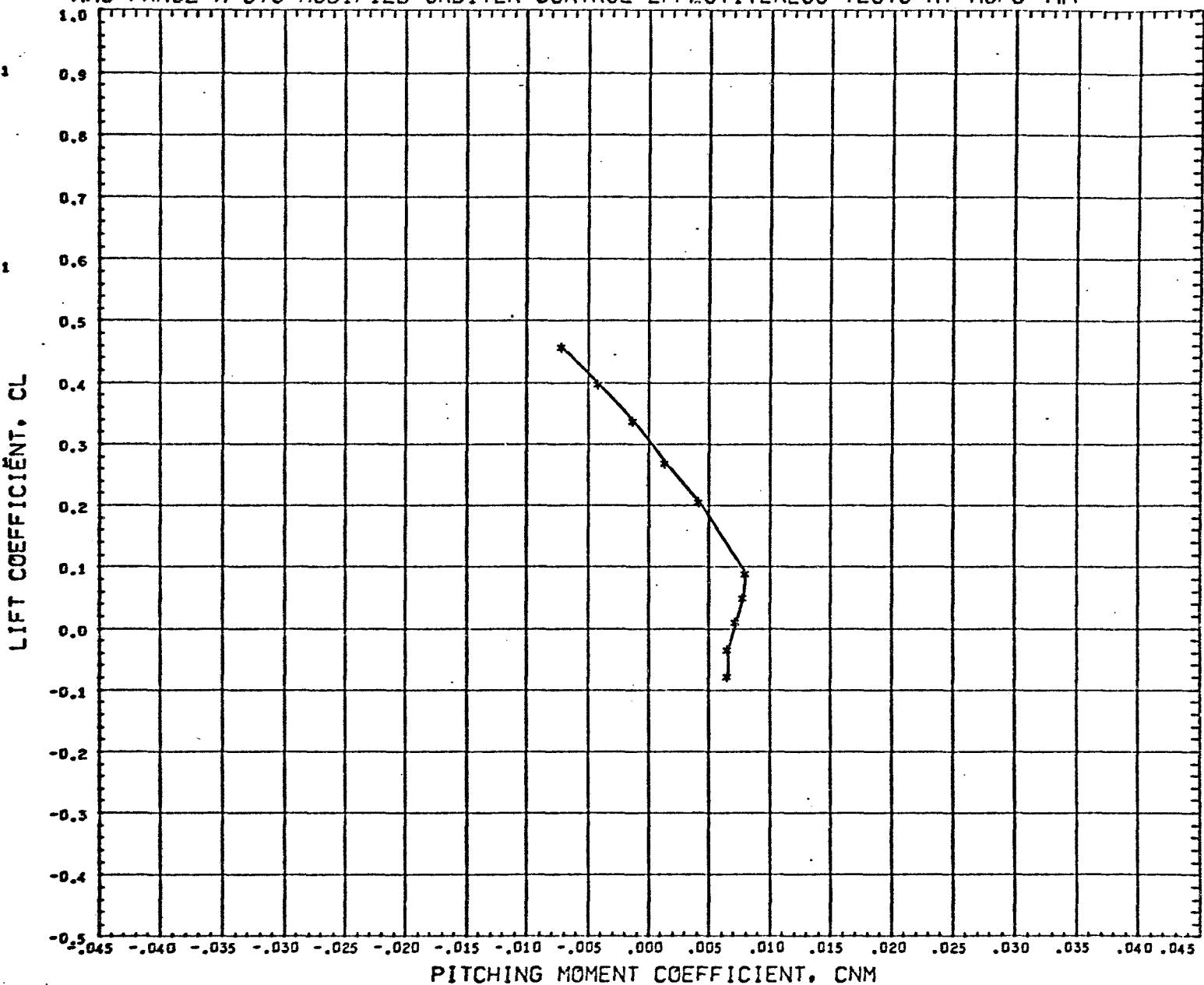
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REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E0

(S17021) 02 JUL 70 PAGE 142

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E0

(S17021) 02 JUL 70 PAGE 143

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



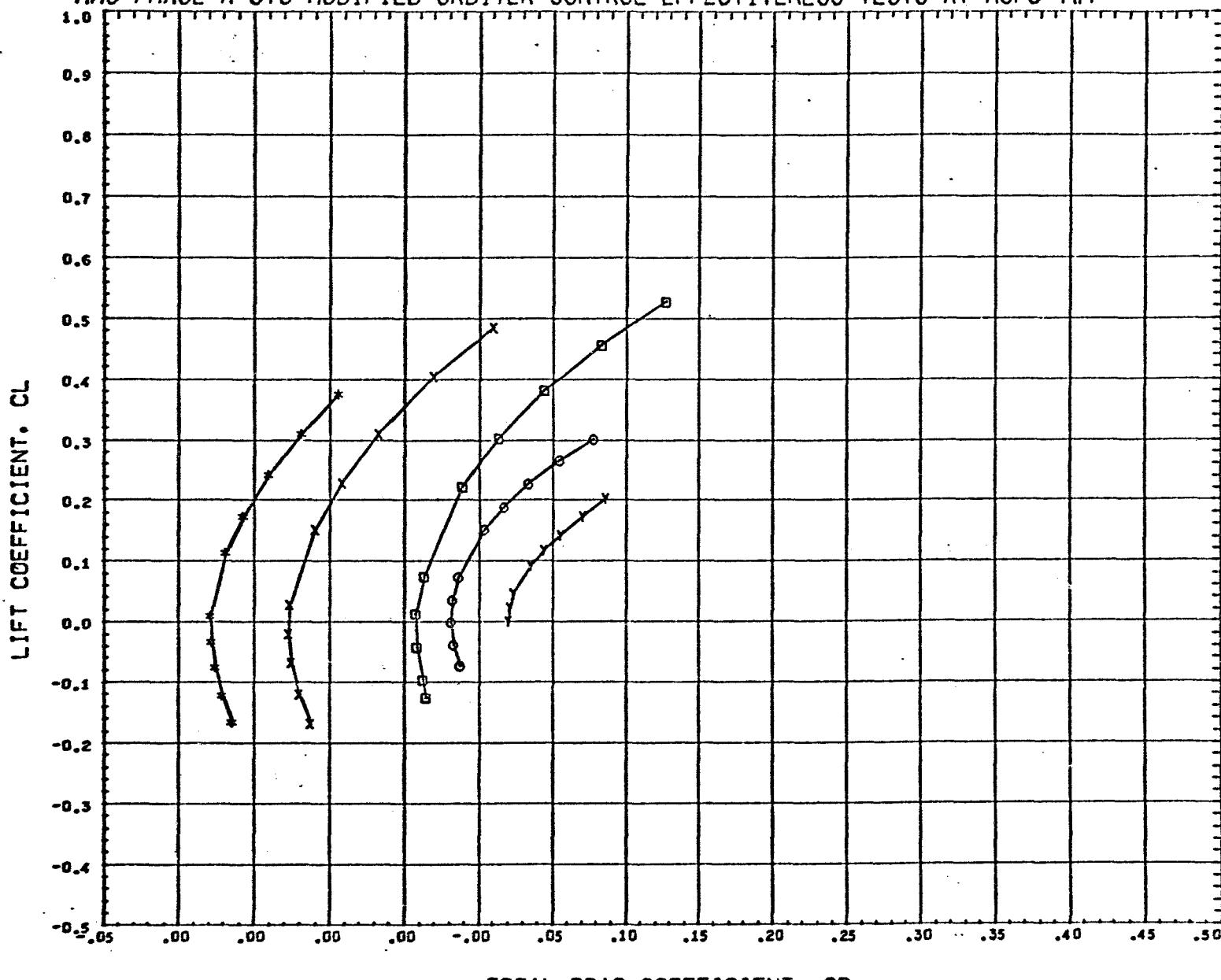
NORMAL FORCE COEFFICIENT, CN

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.397		0.000 ELEVON - 15,000
x	0.797		
o	1.199		
•	2.745		
†	4.960		

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



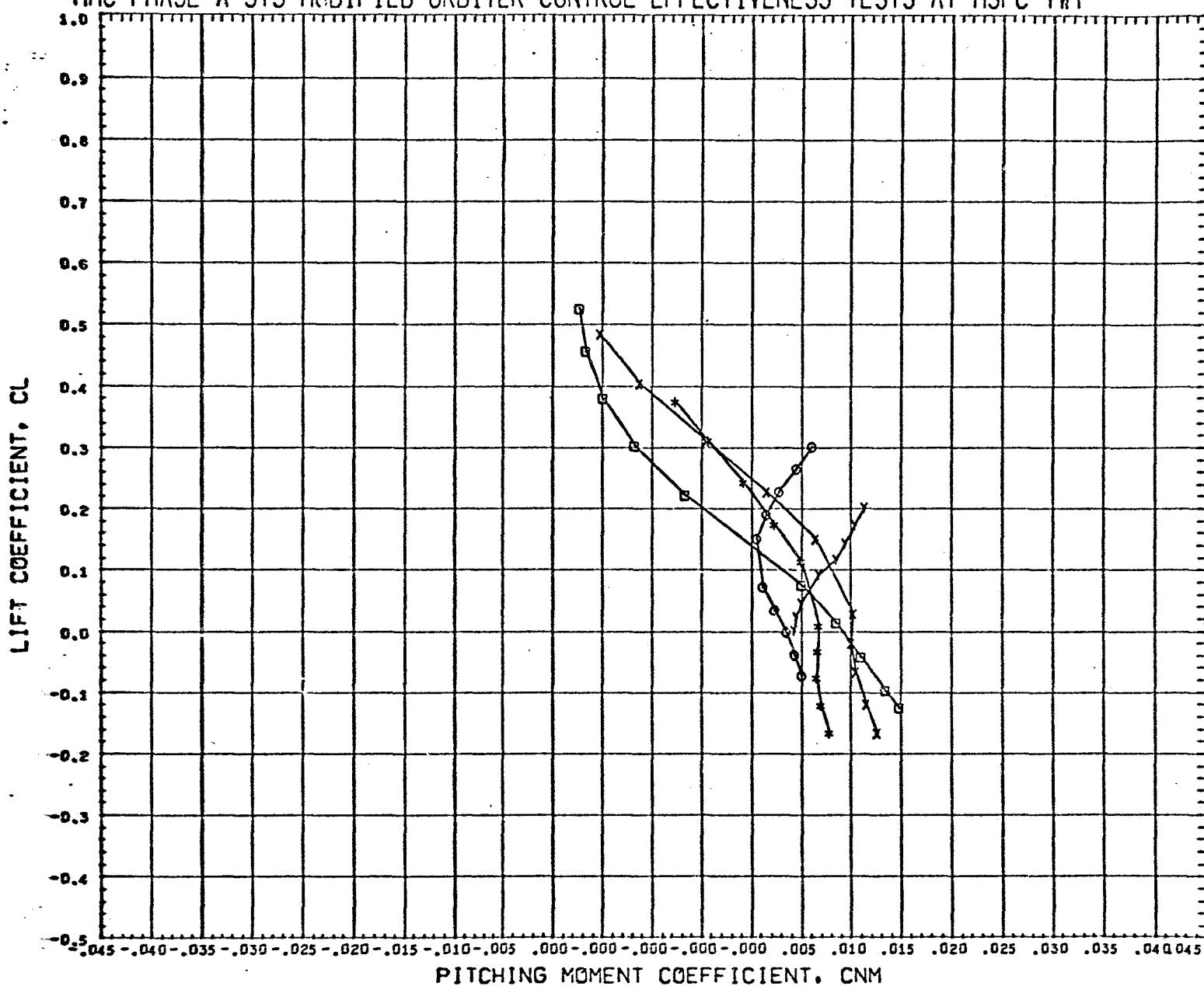
TOTAL DRAG COEFFICIENT, CD

SYMBOL	MACH	PARAMETRIC VALUES	
		BETA	ELEVON - 15.000
*	0.397	9.000	
X	0.797		
C	1.199		
O	2.740		
T	4.960		

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



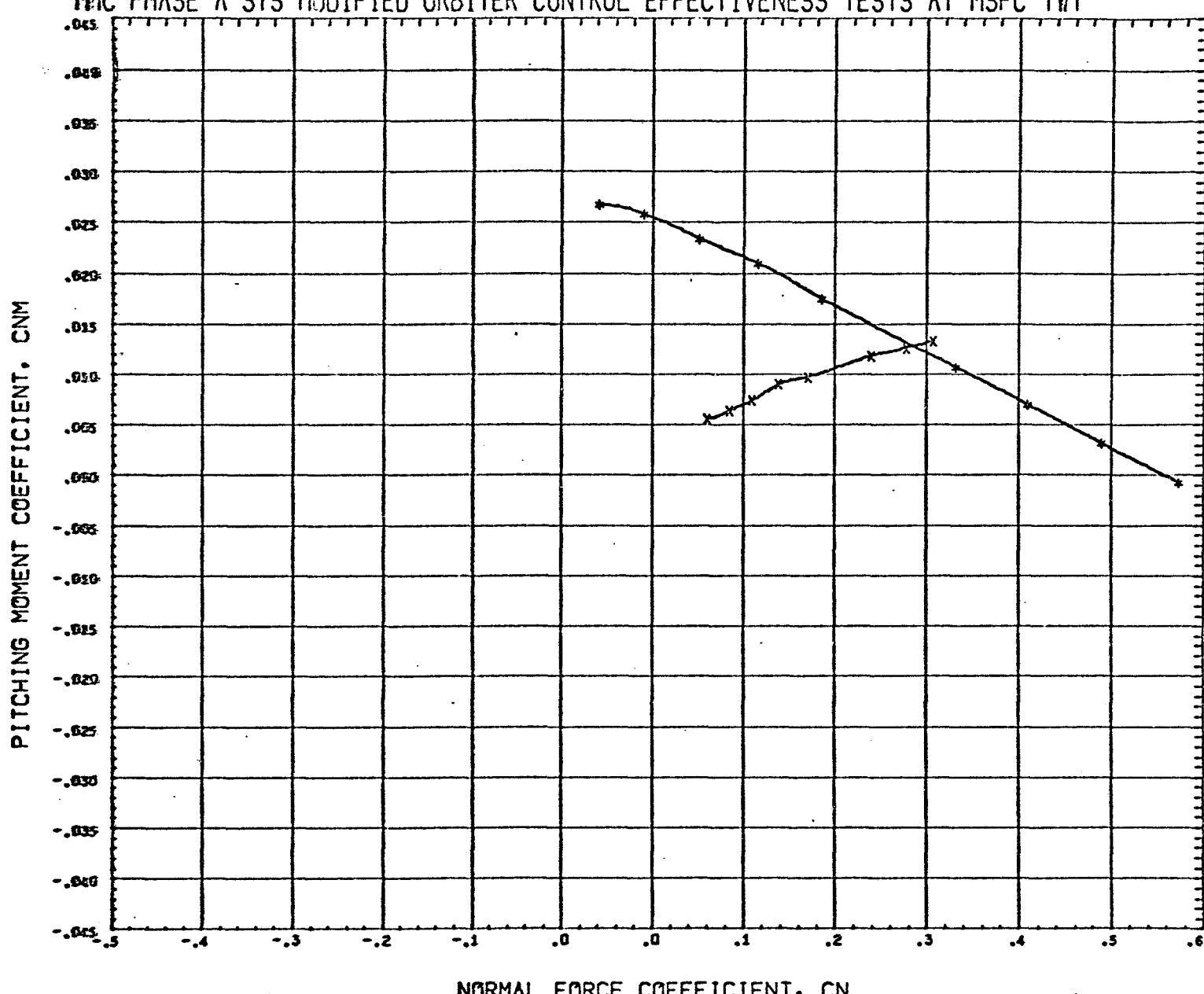
SYMBOL	MACH	PARAMETRIC VALUES		REFERENCE INFORMATION
		BETA	ELEVON	
*	0.397	0.000	15.000	REFS 0.116 SQ.FT.
x	0.797			REFL 0.646 FT.
o	1.199			REFB 0.405 FT.
o	2.740			XHRF 0.406
v	4.960			YHRF 0.000
ZHRF 0.045				

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(S17022) 02 JUL 70 PAGE 146

## HYC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



### NORMAL FORCE COEFFICIENT, CN

**PARAMETRIC VALUES**

<b>SYMBOL</b>	<b>MACH</b>	<b>BETA</b>	<b>0.000</b>	<b>ELEVON</b>	<b>- 15.000</b>
*	0.395				
x	4.960				

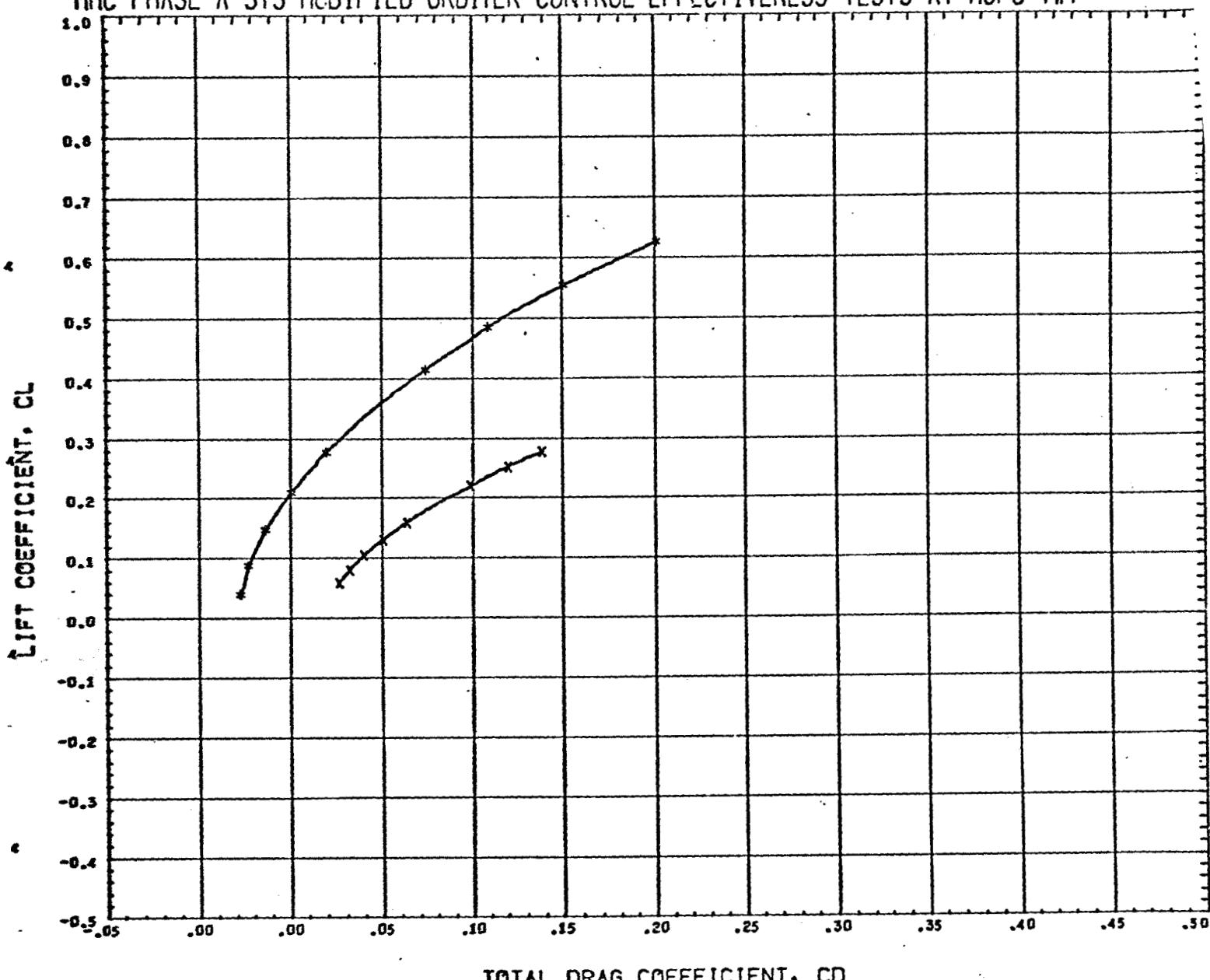
REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

**REFERENCE FILE.**

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(R17023) 02 JUL 70 PAGE 147

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT, CD

SYMBOL MACH BETA PARAMETRIC VALUES  
 \* 0.395 0.050 ELEVON - 15.000  
 x 4.960

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XMRF 0.496  
 YMRF 0.000  
 ZMRF 0.045

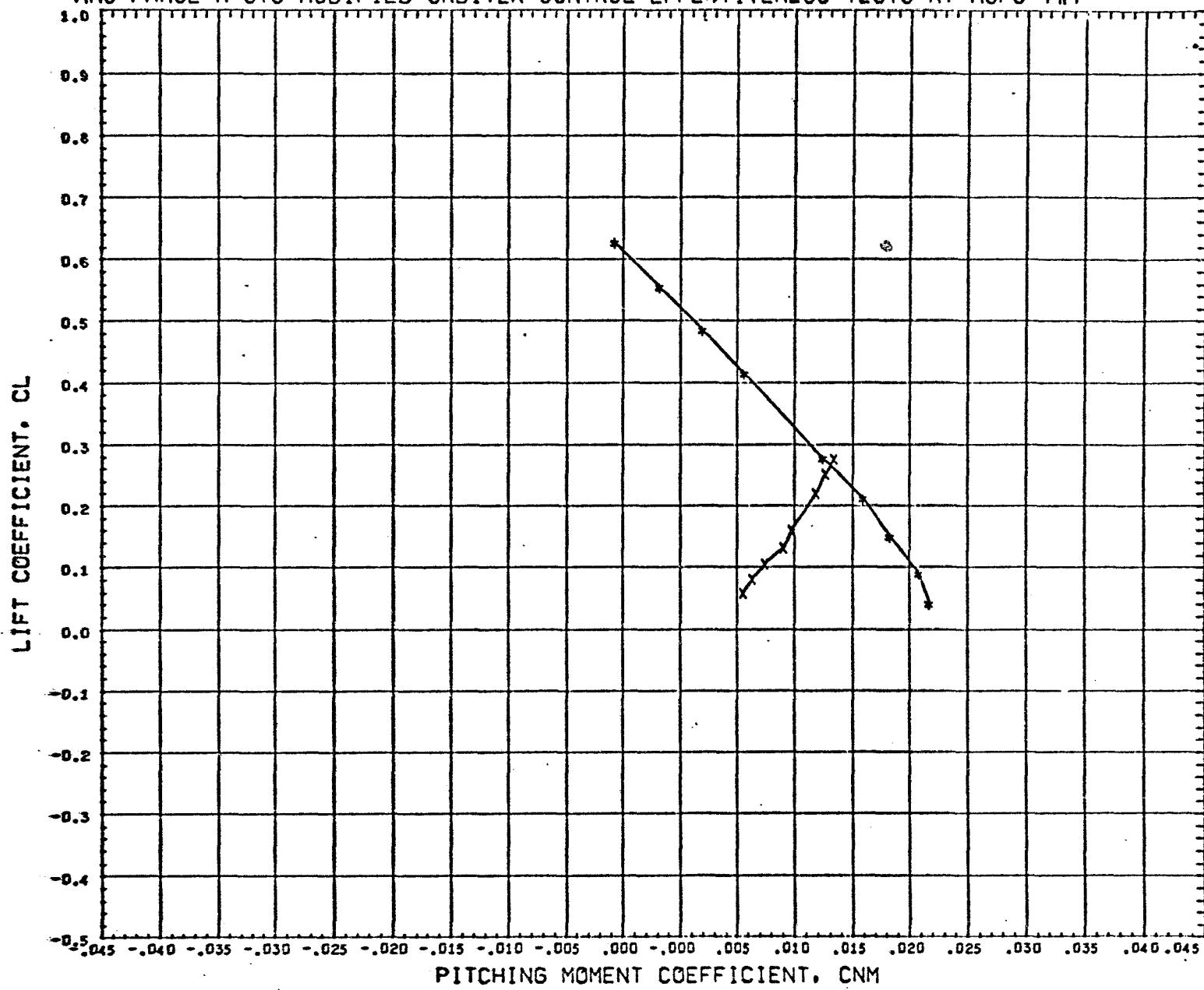
REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(S17023) 02 JUL 70

PAGE 148

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



**PARAMETRIC VALUES**

<b>SYMBOL</b>	<b>MACH</b>	<b>BETA</b>	<b>0.000</b>	<b>ELEVON</b>	<b>- 15.000</b>
*	0.395				
x	4.960				

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

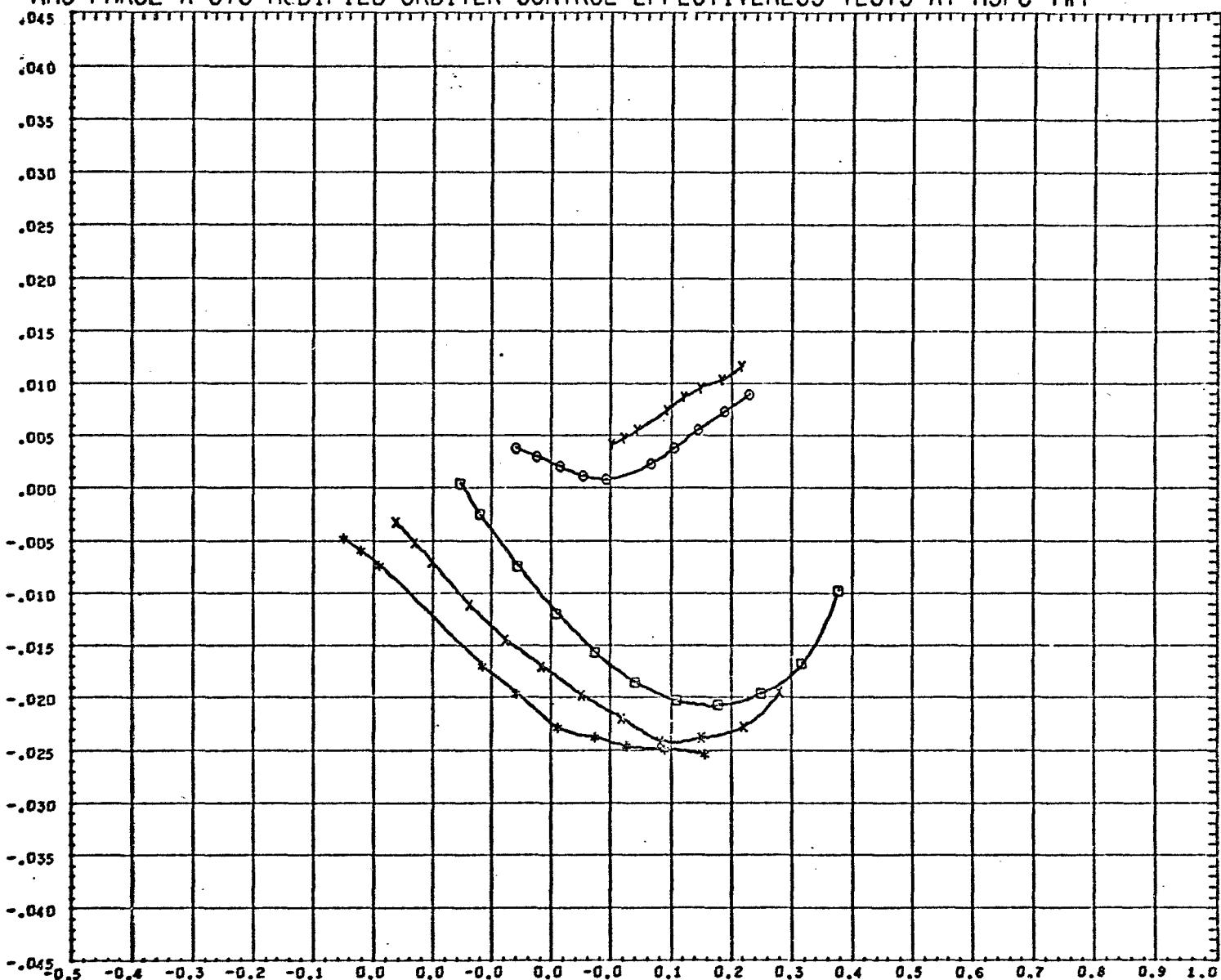
**REFERENCE FILE.**

MSFC 453 MMC MOD ORB B2W2E1 DEL E-15 R0

(S17023) 02 JUL 70 PAGE 149

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



NORMAL FORCE COEFFICIENT, CN

SYMBOL	MACH	BETA	PARAMETRIC VALUES		REFERENCE INFORMATION
			0.000	RUDDER	
*	0.398		0.000	0.000	REFS 0.116 SQ.FT.
x	0.797				REFL 0.646 FT.
o	1.199				REFB 0.405 FT.
e	2.749				XMRF 0.406
v	4.960				YMRF 0.000

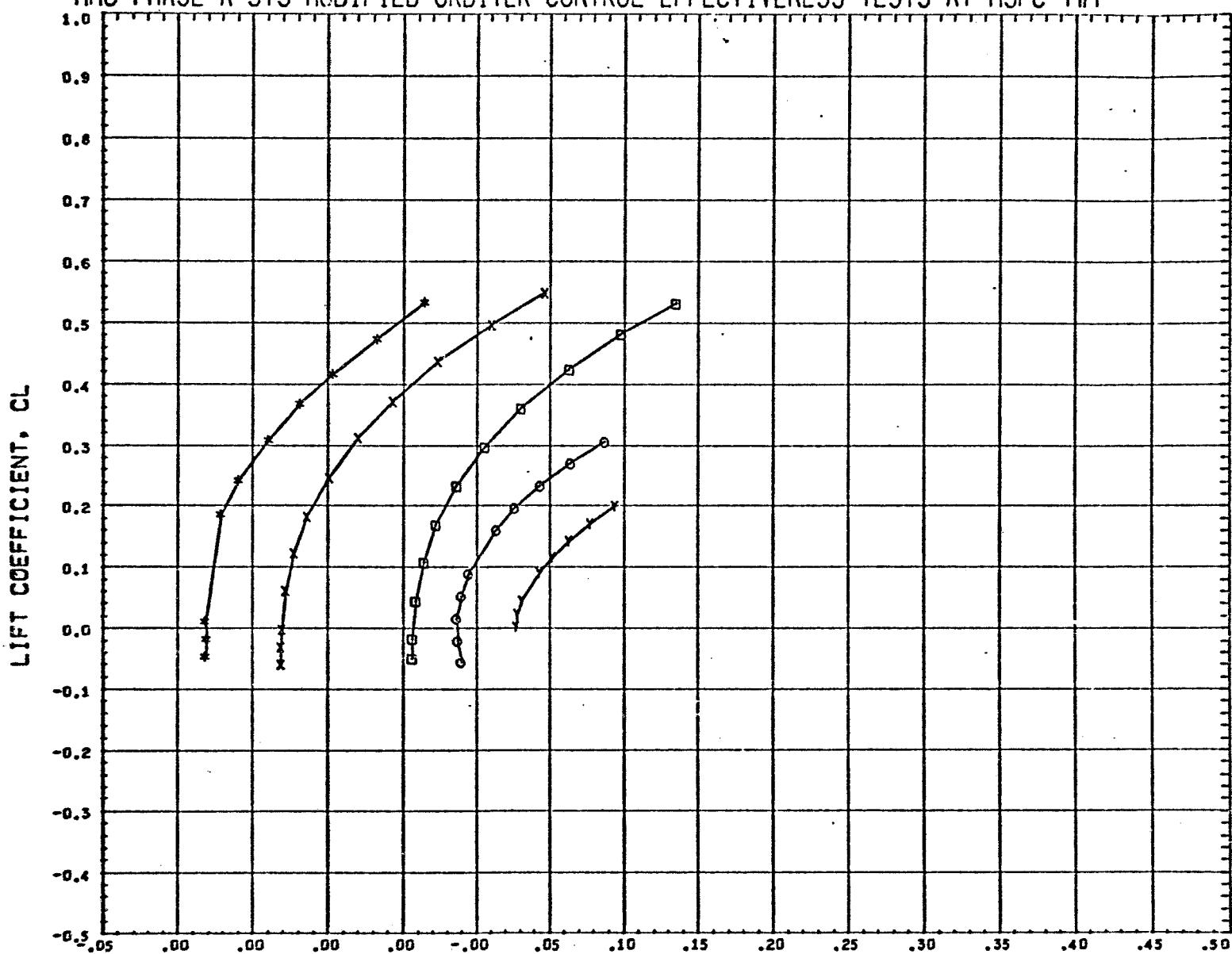
REFERENCE FILE.

REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRF	0.045	

MSFC 453 MMC MOD ORB B2W2T1R1 DEL R0

(R17024) 02 JUL 70 PAGE 150

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



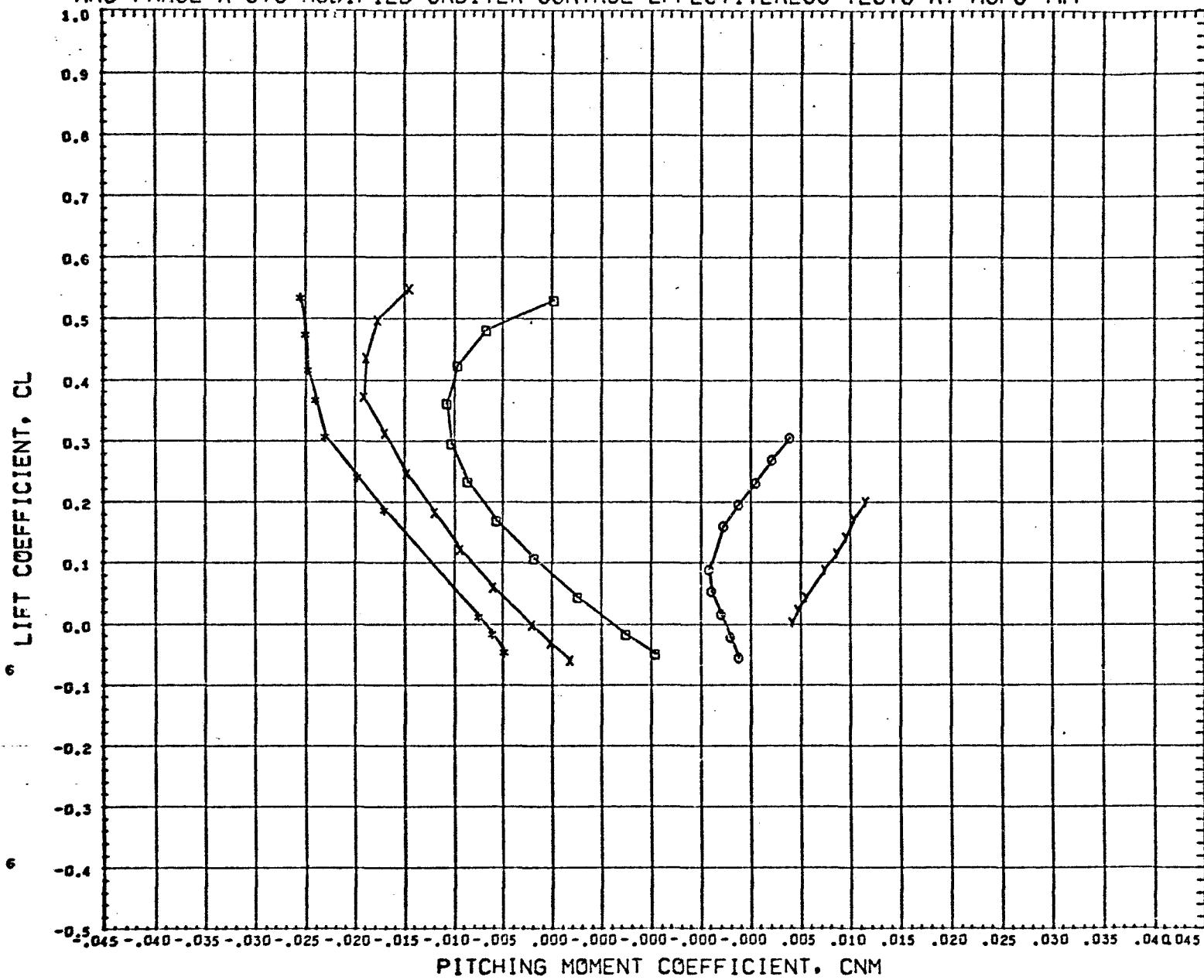
TOTAL DRAG COEFFICIENT, CD

SYMBOL	MACH	PARAMETRIC VALUES		
		BETA	0.000	RUDGER
*	0.398			0.000
x	0.797			
o	1.199			
o	2.749			
▽	4.969			

REFERENCE FILE.

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.398		0.000 RUDDER 0.000
x	0.797		
G	1.199		
6	2.745		
G	1.856		
w			

**REFERENCE FILE.**

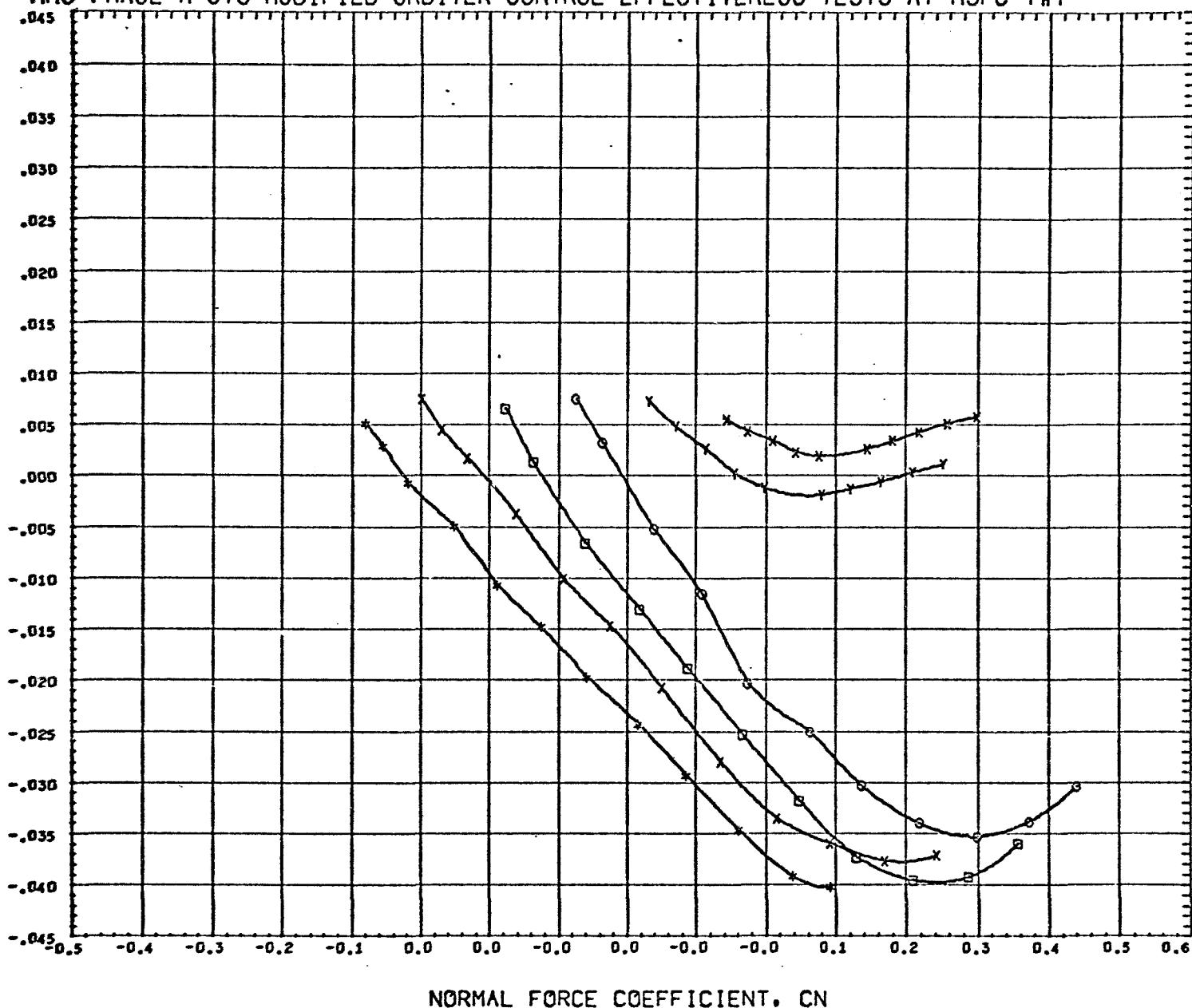
REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFS	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MSFC 453 MMC MOD ORB B2W2T1R1 DEL R0

(S17024) 02 JUL 70 PAGE 152

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CM

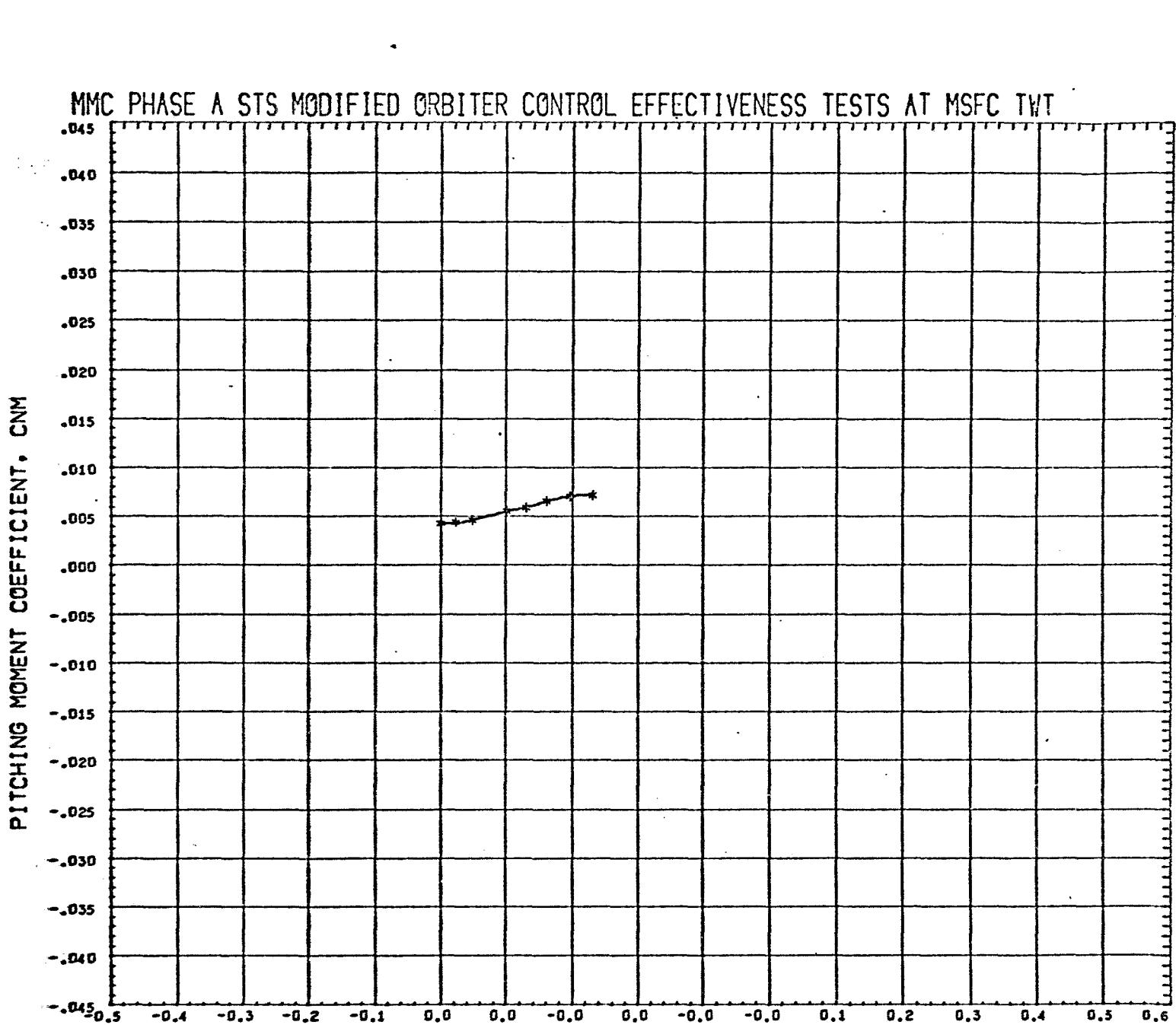


NORMAL FORCE COEFFICIENT, CN

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.396	0.000	ELEVON 0.000
x	0.798	RUDDER 0.000	
o	0.996		
+	1.199		
†	2.740		
x	3.479	REFERENCE FILE.	

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.495 FT.
XMRP 0.406
YMRP 0.000
ZMRP 0.045

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



### NORMAL FORCE COEFFICIENT, CN

SYMBOL	MACH	PARAMETRIC VALUES		
*	4.960	BETA	0.500	ELEVON
		RUDDER	0.500	0.000

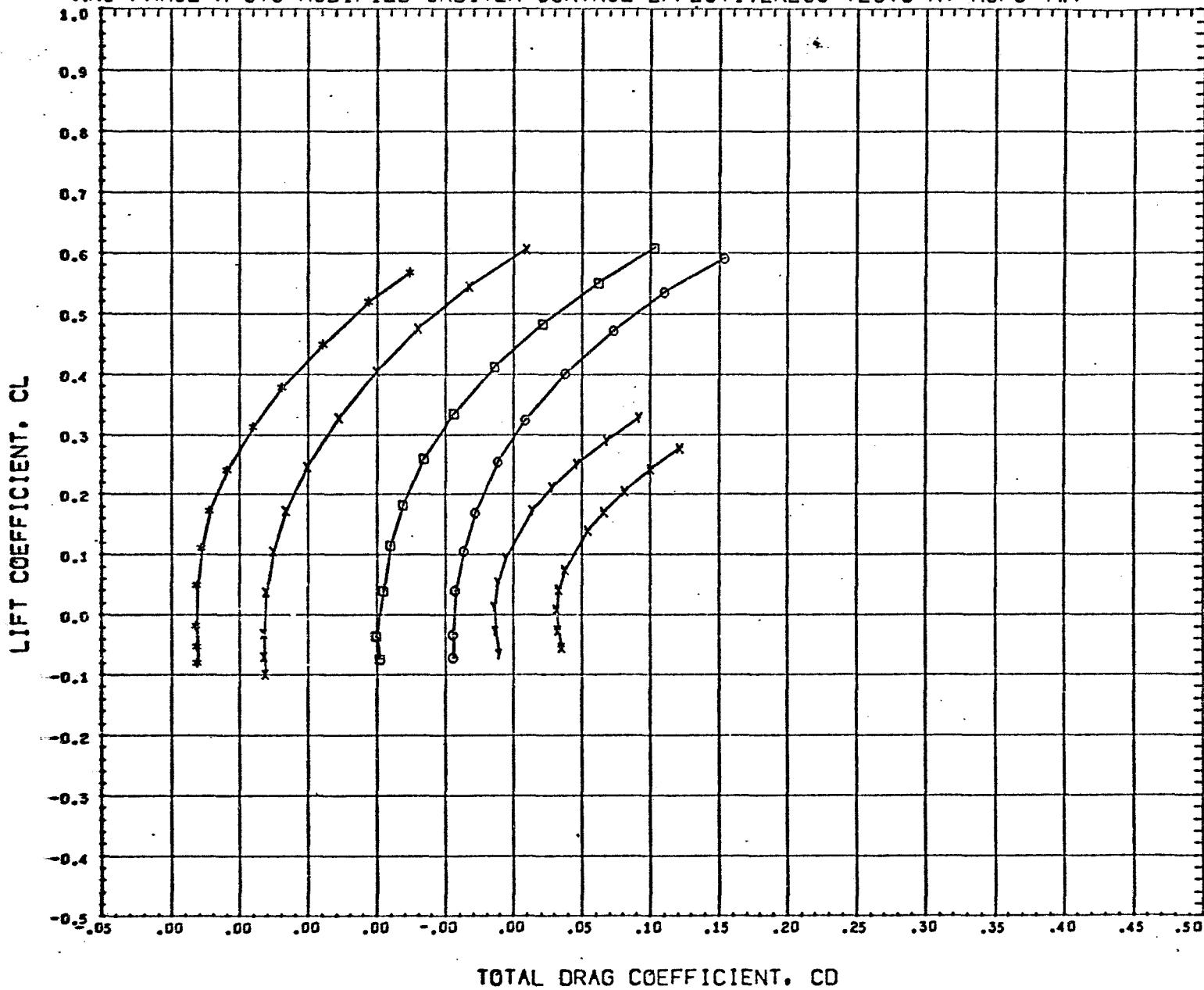
REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRF	0.045	

**REFERENCE FILE.**

MSFC 453 MMC MOD ORB 82W2T1E1R1 DEL E0 R0

(R17025) 02 JUL 70 PAGE 154

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



<b>SYMBOL</b>	<b>MACH</b>	<b>PARAMETRIC VALUES</b>		
*	0.396	BETA	0.000	ELEVON
x	0.798	RUDDER	0.000	
G	0.996			
G	1.193			
V	2.740			
X	3.479	REFERENCE FILE.		

## TOTAL DRAG COEFFICIENT, CD

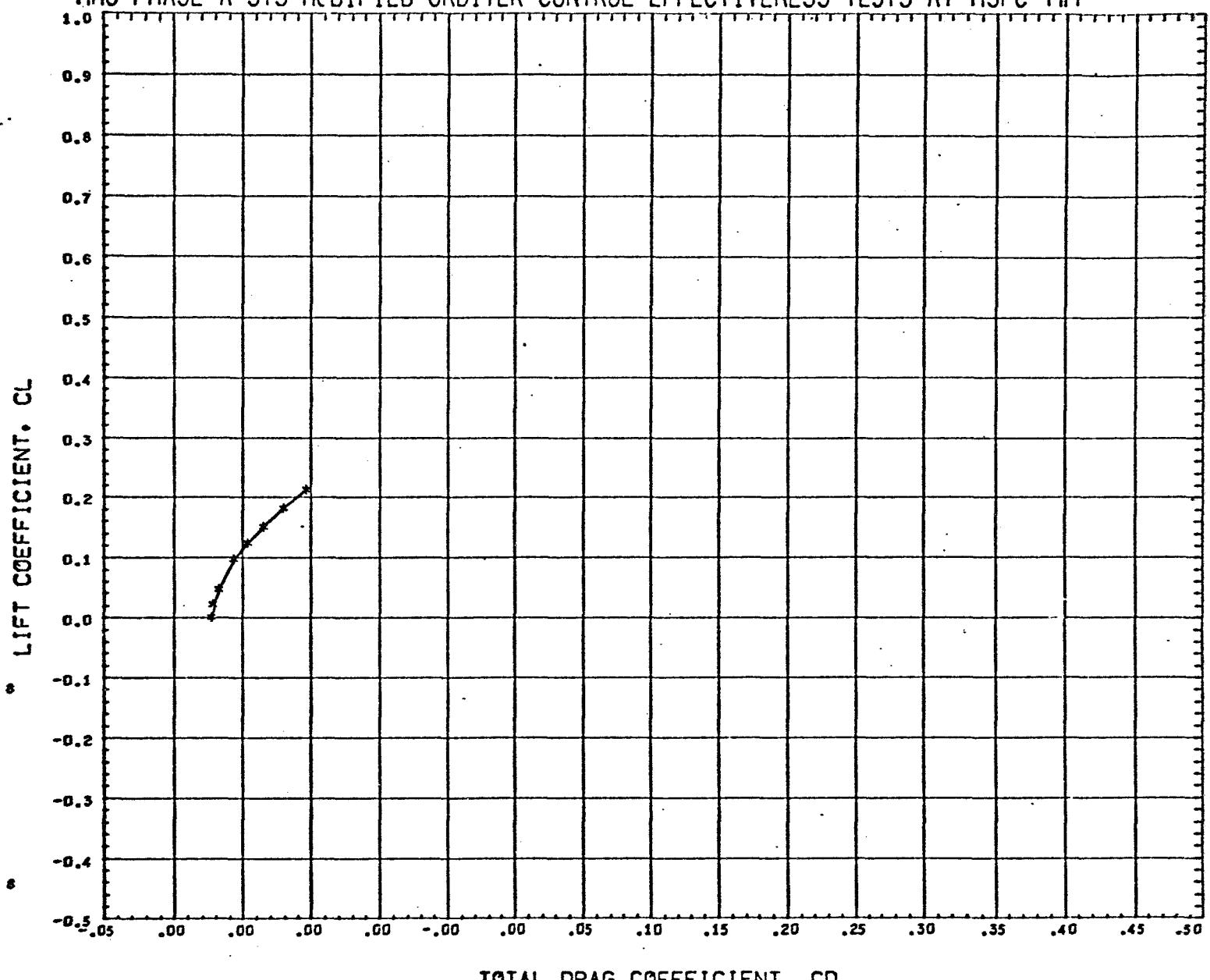
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REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YMRF	0.000	
ZMRF	0.045	

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

(S17025) 02 JUL 70

PAGE 155

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



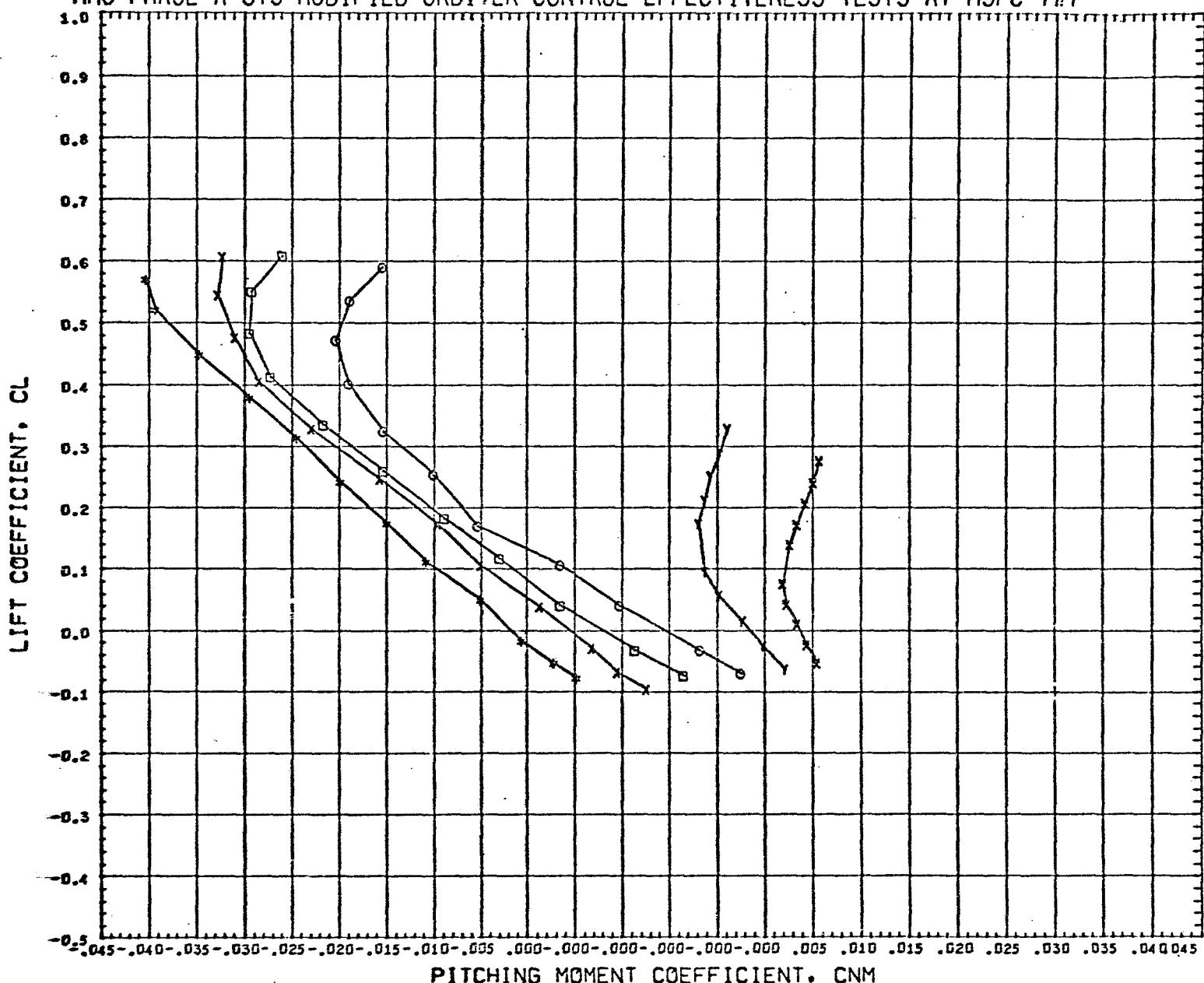
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MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E0 R0

(S17025) 02 JUL 70

PAGE 156

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



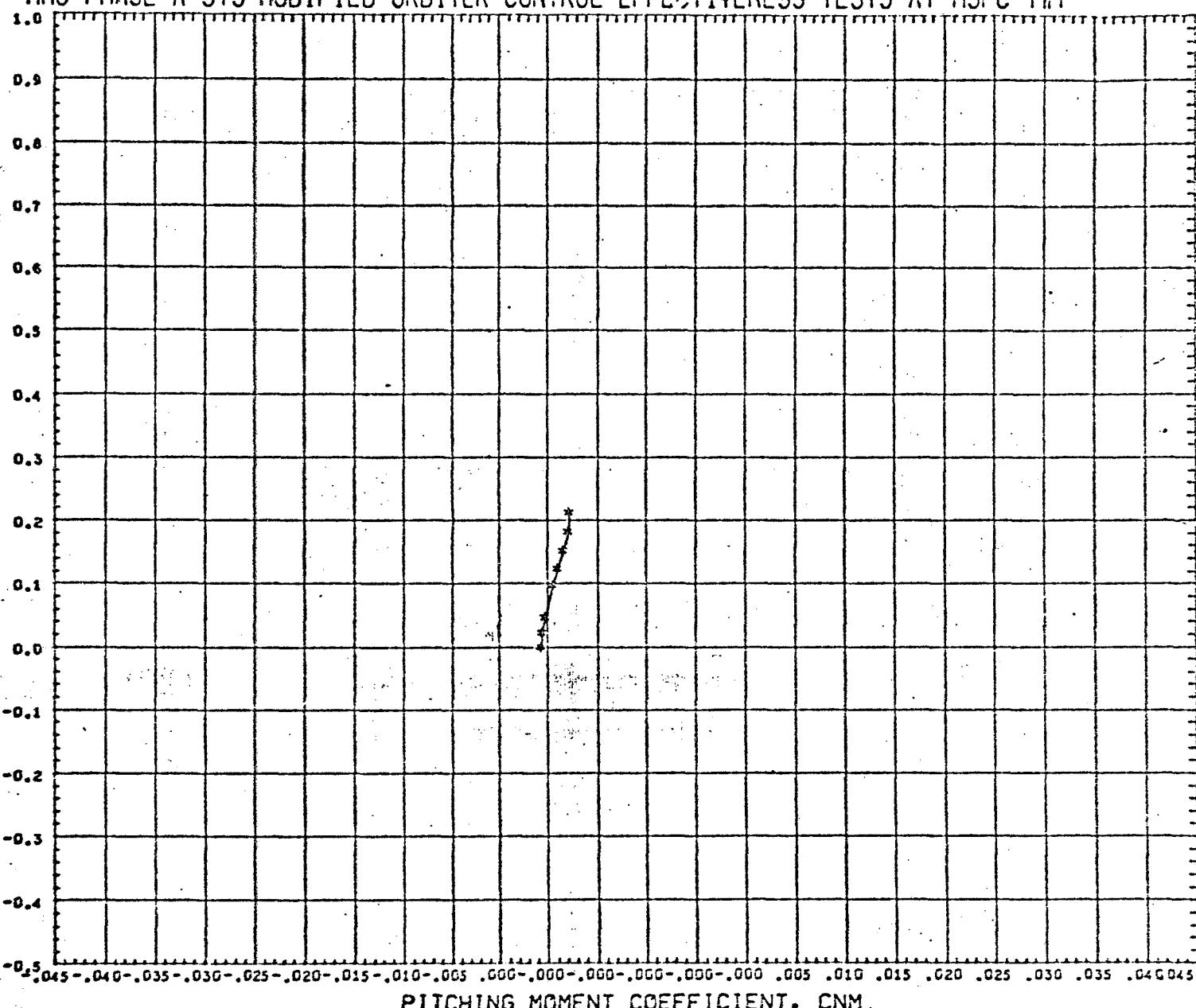
PITCHING MOMENT COEFFICIENT. CMN

SYMBOL	MACH	BETA	PARAMETRIC VALUES	ELEVON	ELEVON
*	0.396		0.500	0.500	
x	0.798	RUDDER	0.500		
o	0.996				
△	1.199				
y	2.745				
x	3.479	REFERENCE FILE.			

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

LIFT COEFFICIENT, CL



PITCHING MOMENT COEFFICIENT, CNM.

SYMBOL MACH                    PARAMETRIC VALUES  
       \* 4.960                  BETA      0.000            ELEVON    0.000  
                                 RUDDER    0.000

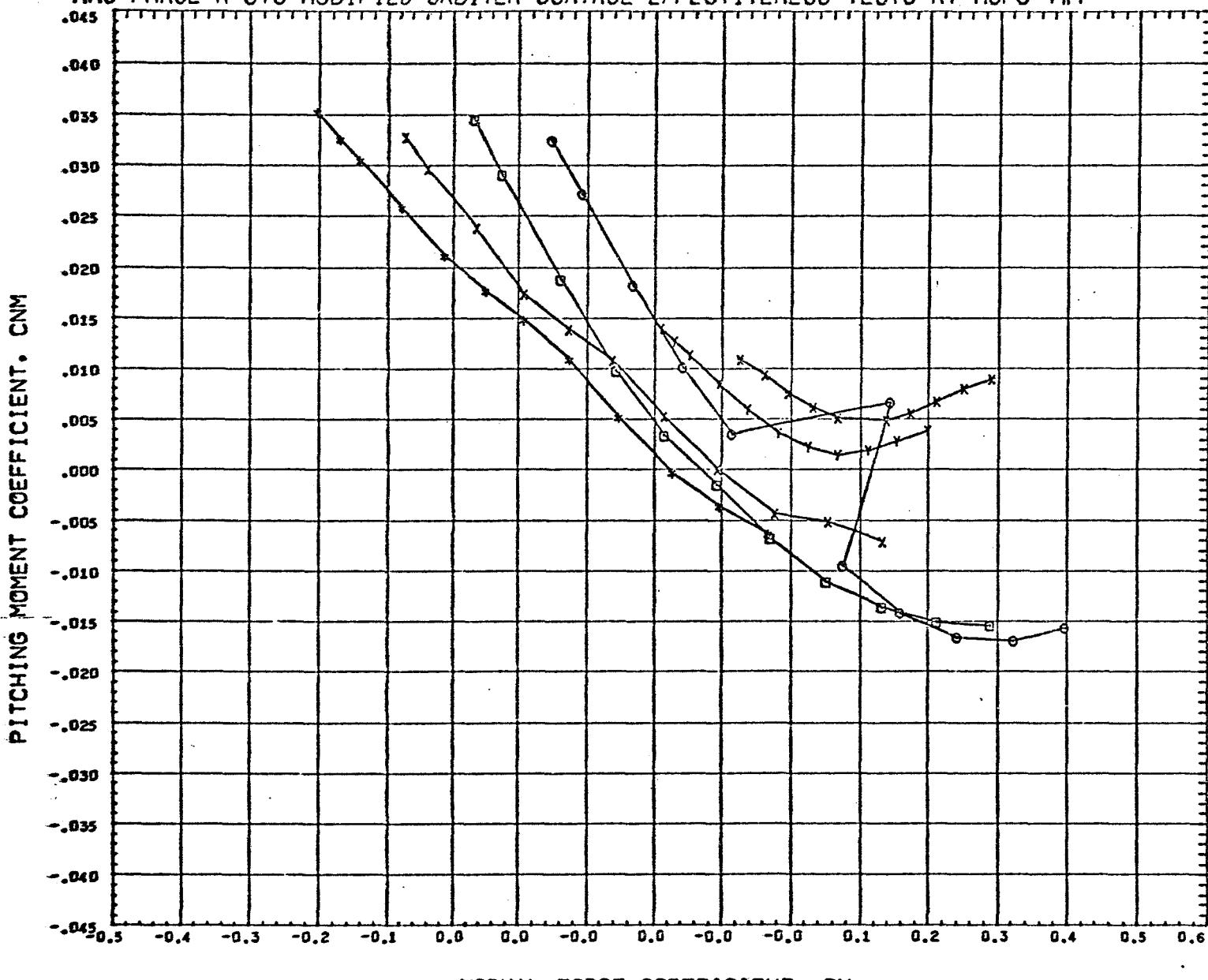
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRF	0.045	

REFERENCE FILE.

MSFC 453 MMC MGD ORB B2W2T1E1R1 DEL E0 R0

(S17025) 02 JUL 70 PAGE 158

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

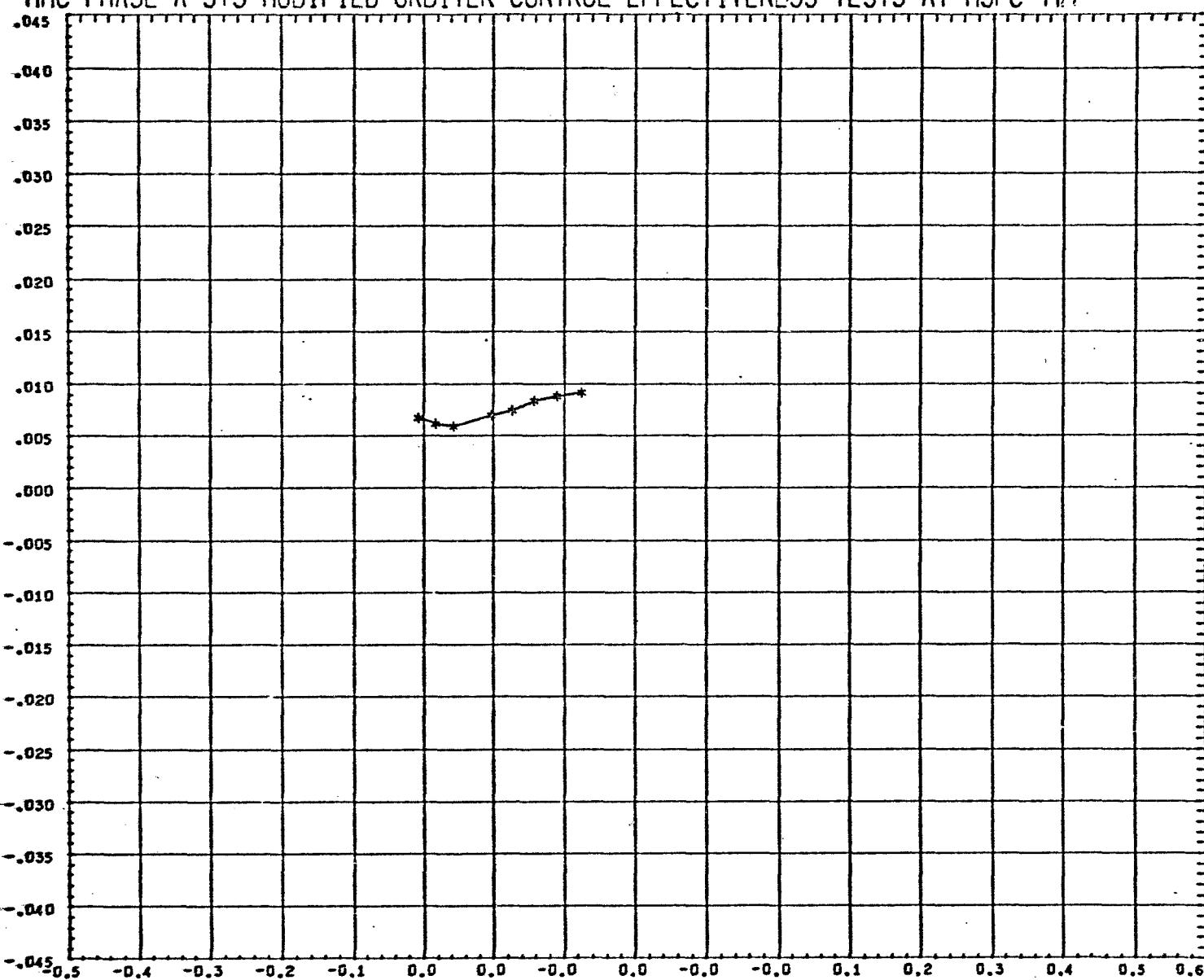


PARAMETRIC VALUES	
*	MACH 0.398
x	BETA 0.000
o	RUDGER 0.000
+	ELEVON - 15,000
-	
*	3.479
REFERENCE FILE.	

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT "COEFFICIENT. CNM



NORMAL FORCE COEFFICIENT. CN

SYMBOL MACH PARAMETRIC VALUES  
 \* 4.969 BETA 0.000 ELEVON - 15.000  
 RUDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XMRF 0.406  
 YMRF 0.000  
 ZMRF 0.045

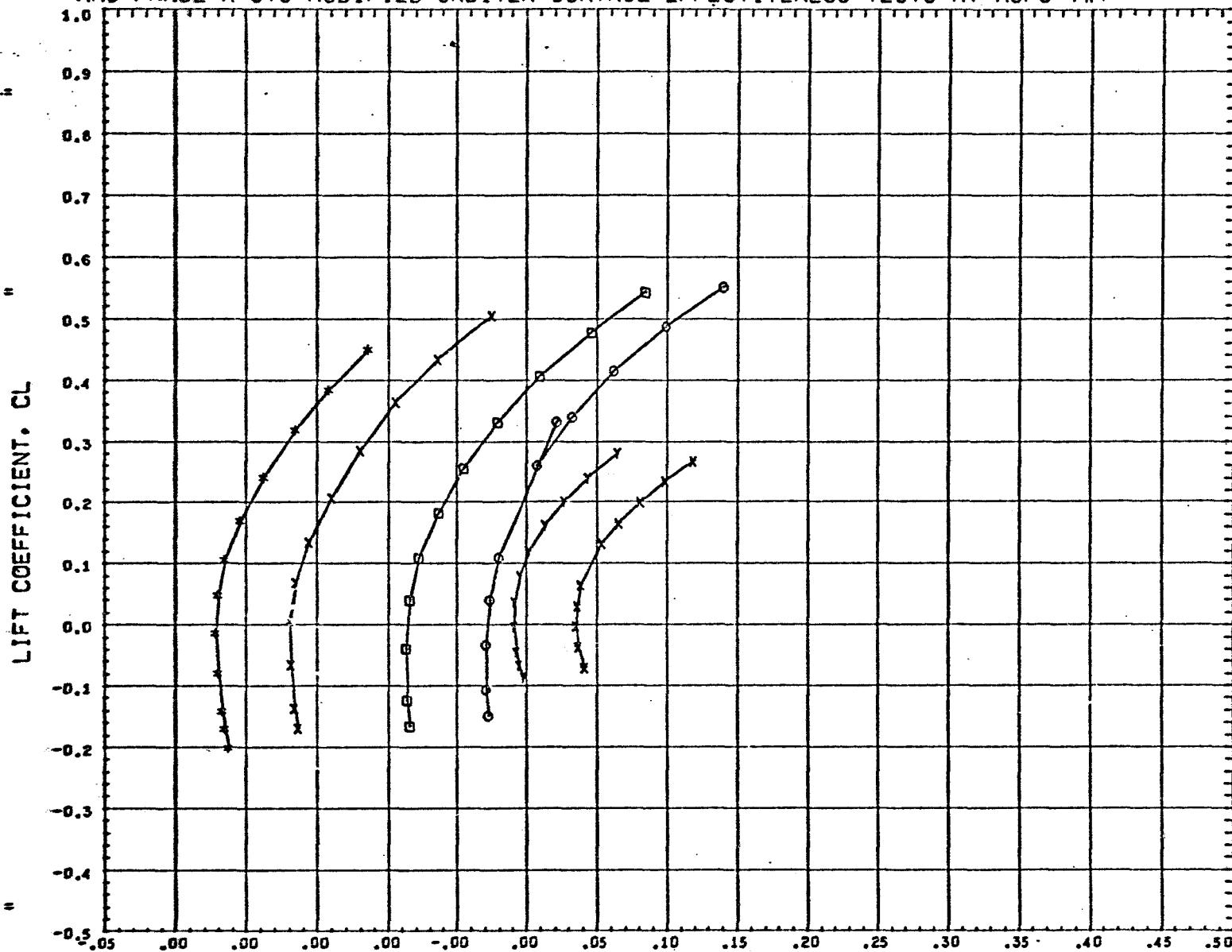
REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(R17026) 02 JUL 70

PAGE 160

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT, CD

SYMBOL	MACH	PARAMETRIC VALUES	
●	0.398	BETA	0.000 ELEVON - 15.000
×	0.797	RUDER	0.000
○	0.997		
◊	1.211		
▽	2.740		
×	3.479		
REFERENCE FILE.			

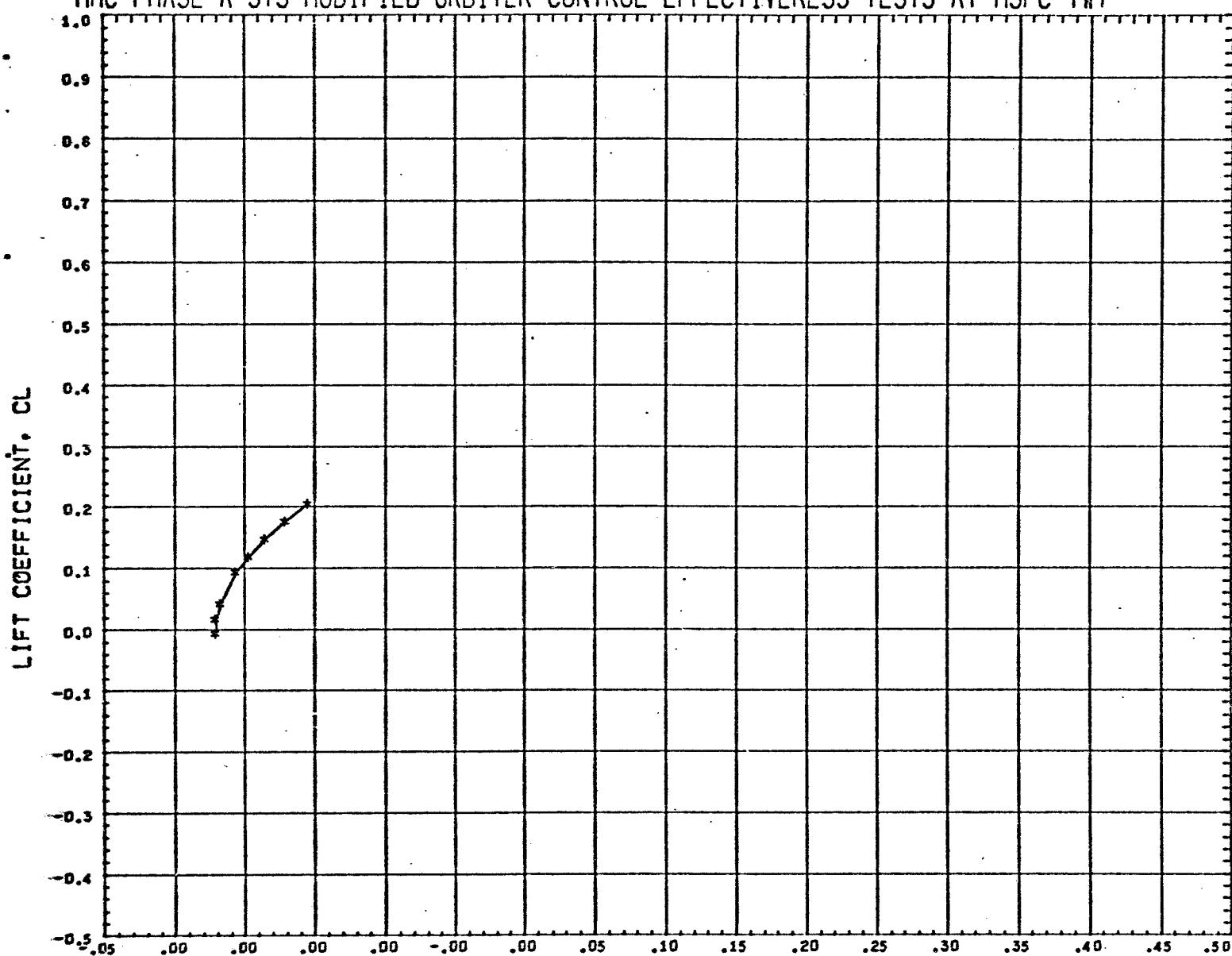
REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(S17026) 02 JUL 70

PAGE 161

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT, CD

SYMBOL MACH PARAMETRIC VALUES  
 \* 4.965 BETA 0.000 ELEVON - 15.000  
 \* RUDDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XHRF 0.406  
 YHRF 0.000  
 ZHRF 0.045

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(S17026) 02 JUL 70

PAGE 162

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



PITCHING MOMENT COEFFICIENT, CM

SYMBOL	MACH	PARAMETRIC VALUES	
		BETA	ELEVON - 15.000
•	0.398	0.000	
x	0.797	- RUDDER	0.000
△	0.997		
*	1.211		
▽	2.740		
□	3.679	REFERENCE FILE.	

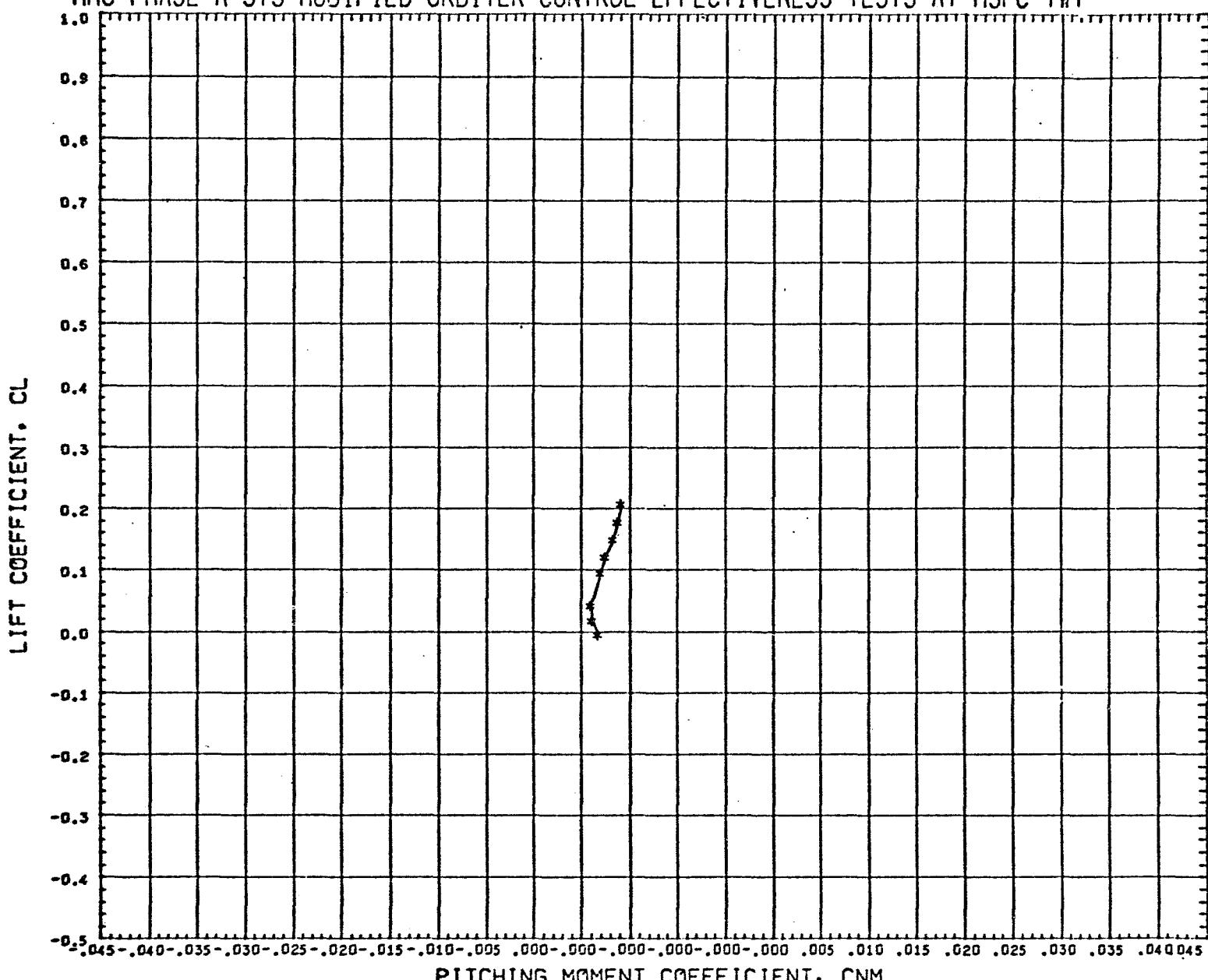
REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRF	0.045	

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(S17026) 02 JUL 70

PAGE 163

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL MACH PARAMETRIC VALUES  
 \* 4.965 BETA 0.000 ELEVON - 15.000  
 RUDGER 0.000

REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YMRF	0.000	
ZMRF	0.045	

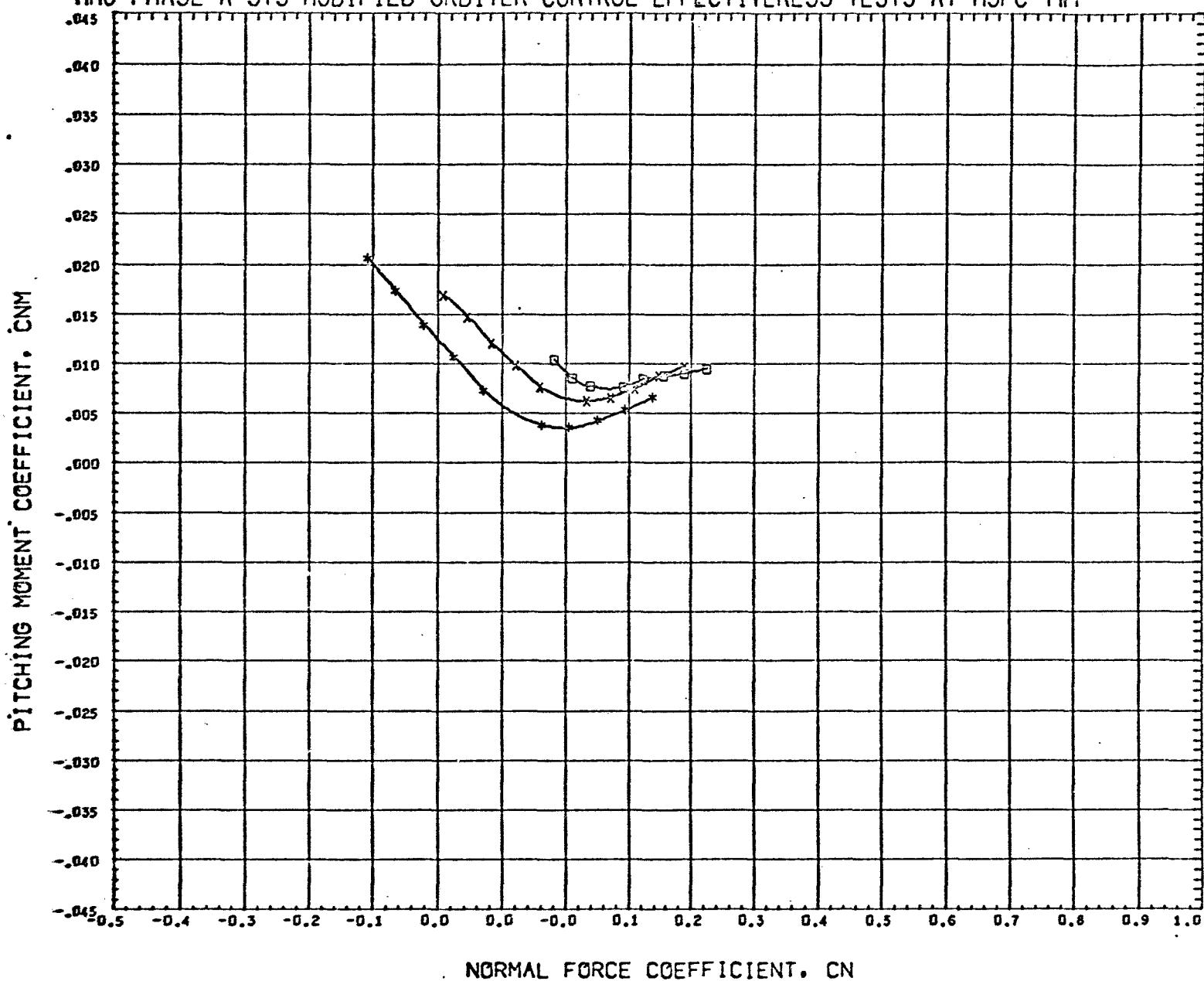
REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(S17026) 02 JUL 70

PAGE 164

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



## NORMAL FORCE COEFFICIENT. CN

SYMBOL	MACH		PARAMETRIC VALUES		
*	2.745	BETA	0.000	ELEVON	- 30.000
x	3.479	RUDDER	0.000		
□	4.965				

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

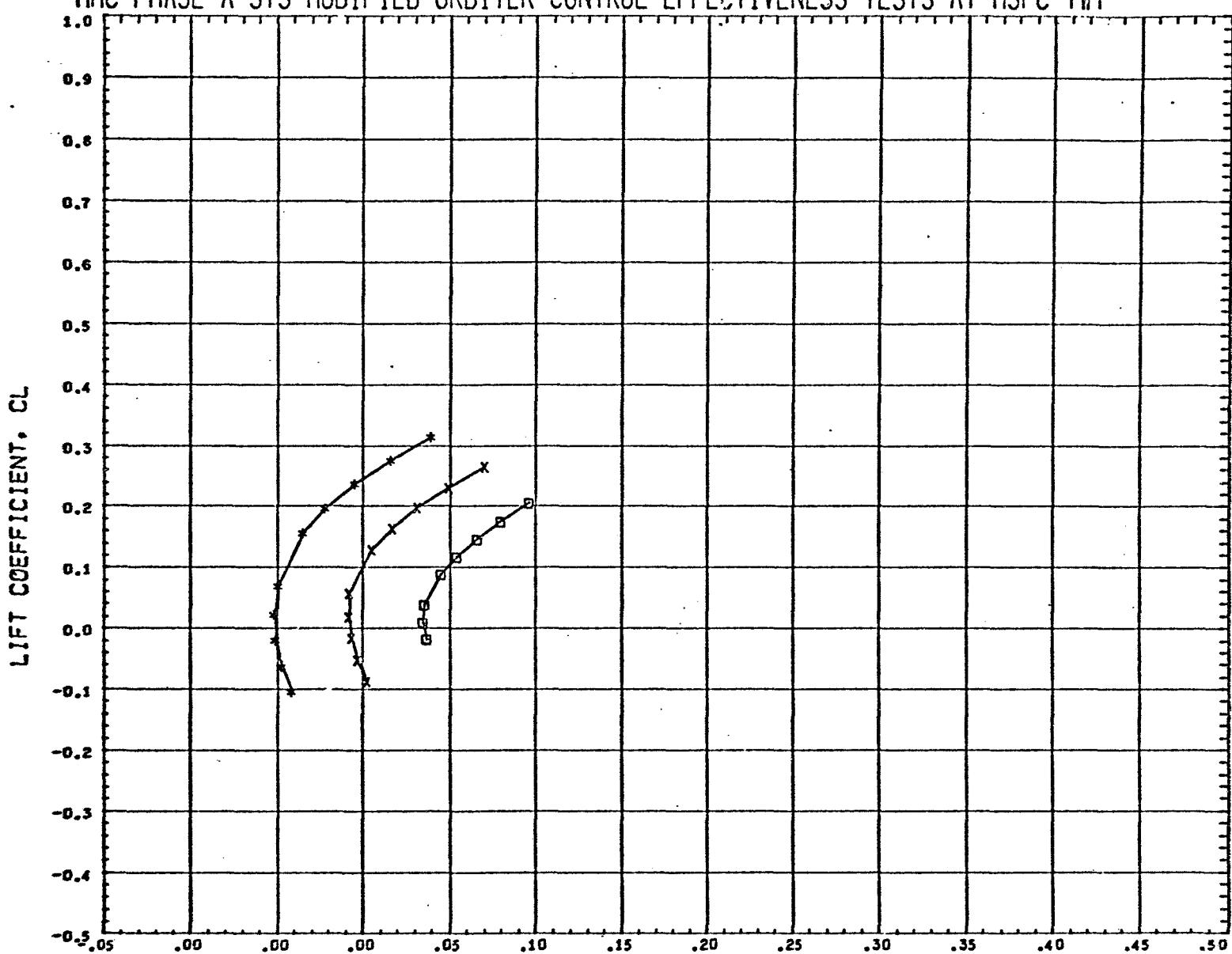
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-MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17027) 02 JUL 70

PAGE 165

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT, CD

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	2.740	0.000	ELEVON - 30.000
x	3.479	0.000	
□	4.960		

REFERENCE	INFORMATION
REFS	0.116 SQ.FT.
REFL	0.646 FT.
REFB	0.405 FT.
XHRF	0.406
YHRF	0.000
ZHRF	0.045

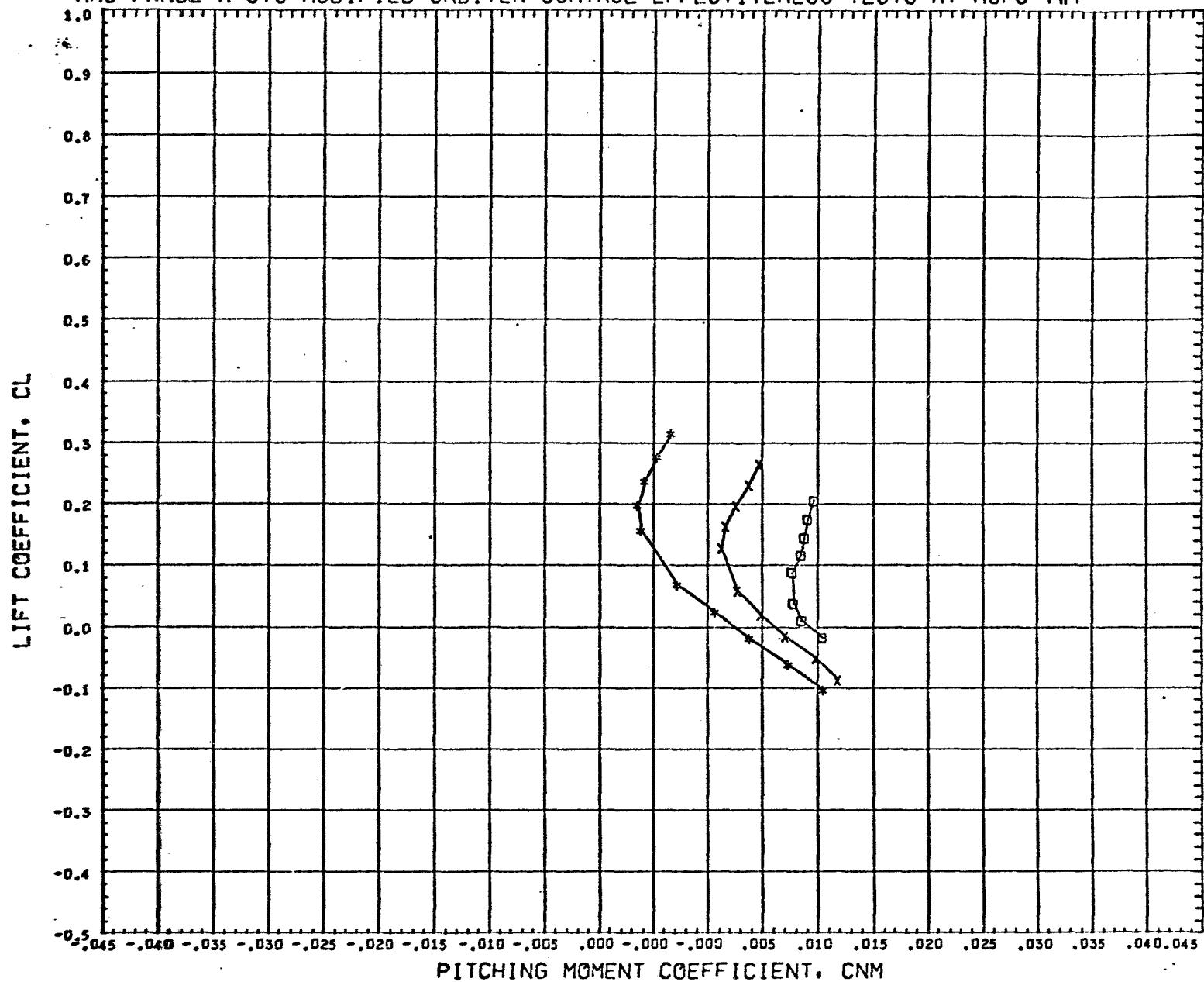
REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(S17027) 02 JUL 70

PAGE 166

## MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH		PARAMETRIC VALUES
*	2.740	BETA	0.000 ELEVON - 30.000
x	3.479	RUDDER	0.000
o	4.965		

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XMRF	0.406	
YNRF	0.000	
ZMRF	0.045	

**REFERENCE FILE.**

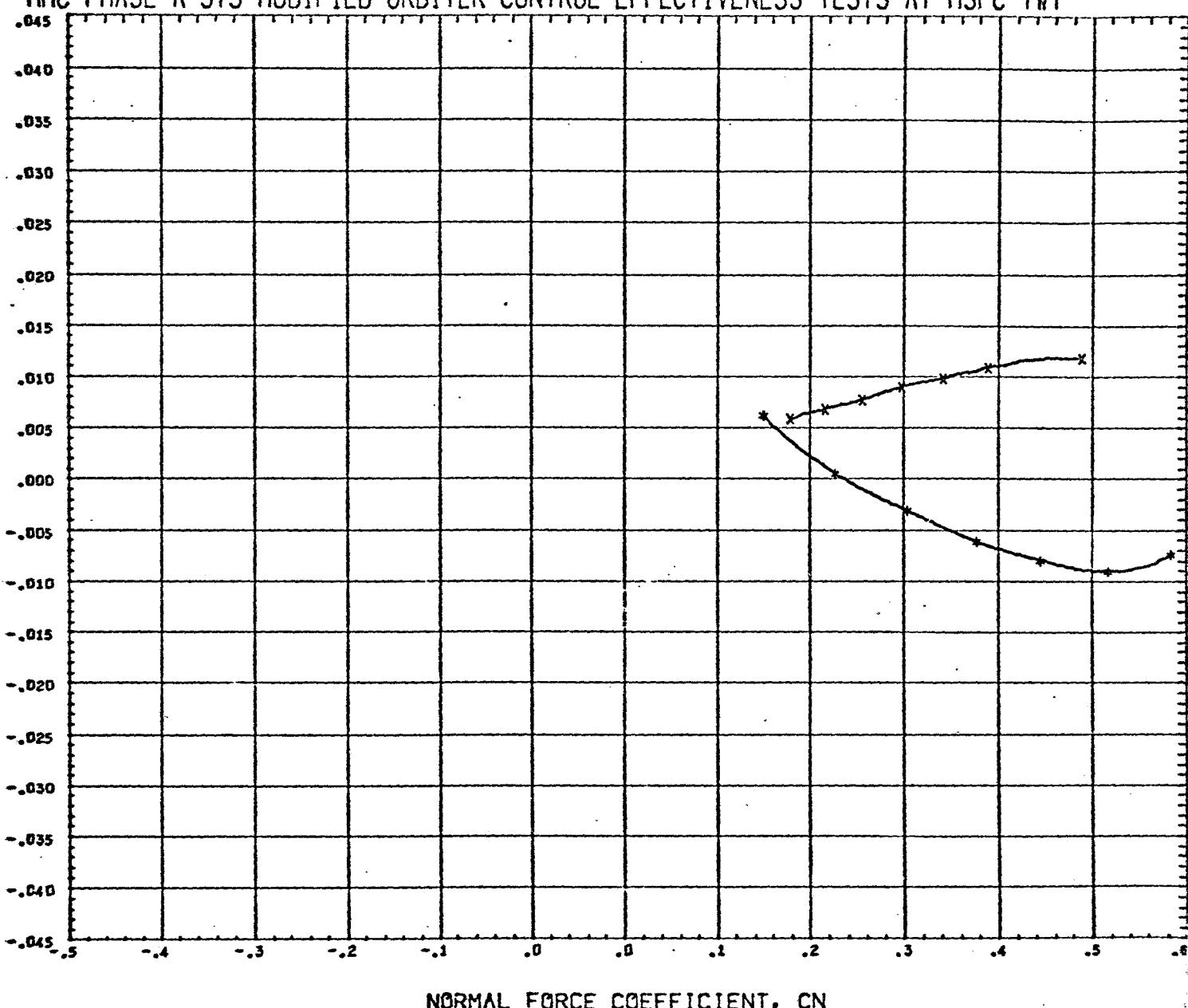
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(S17027) 02 JUL 70

PAGE 167

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



NORMAL FORCE COEFFICIENT, CN

SYMBOL	MACH	BETA	PARAMETRIC VALUES
*	0.398	0.000	ELEVON - 15.000
x	3.479	0.000	RUDDER

REFERENCE INFORMATION
REFS 0.116 SR.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.406
YMRP 0.000
ZHRF 0.045

REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(R17028) 02 JUL 70

PAGE 168

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT, CD

SYMBOL MACH PARAMETRIC VALUES  
 \* 0.398 BETA 0.000 ELEVON - 15.000  
 x 3.479 RUDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.495 FT.  
 XMRF 0.436  
 TMRF 0.000  
 ZMRF 0.045

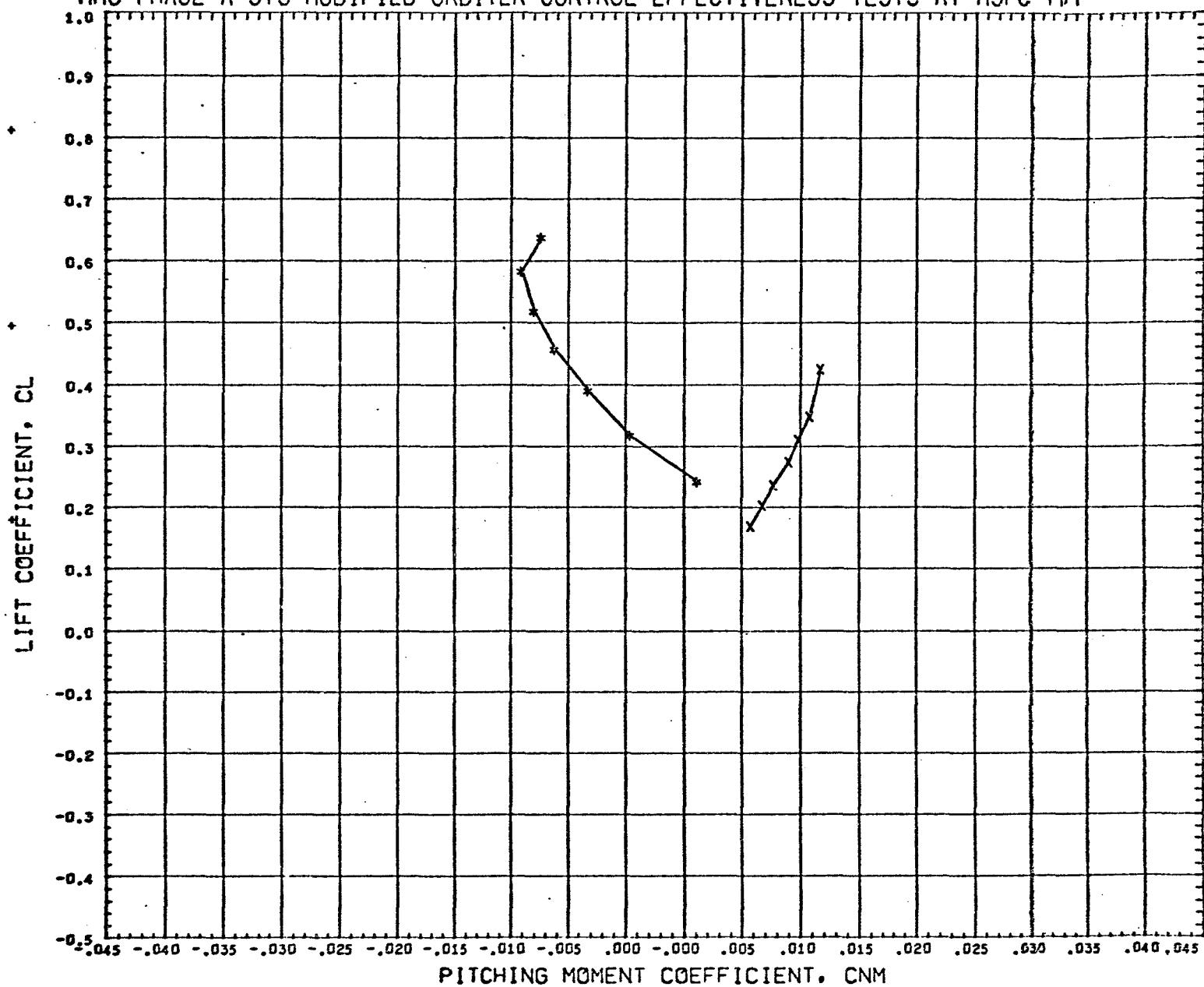
REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(S17028) 02 JUL 70

PAGE 169

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	MACH	PARAMETRIC VALUES		
•	0.398	BETA	0.000	ELEVON - 15.000
x	3.479	RUDDER	0.000	

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

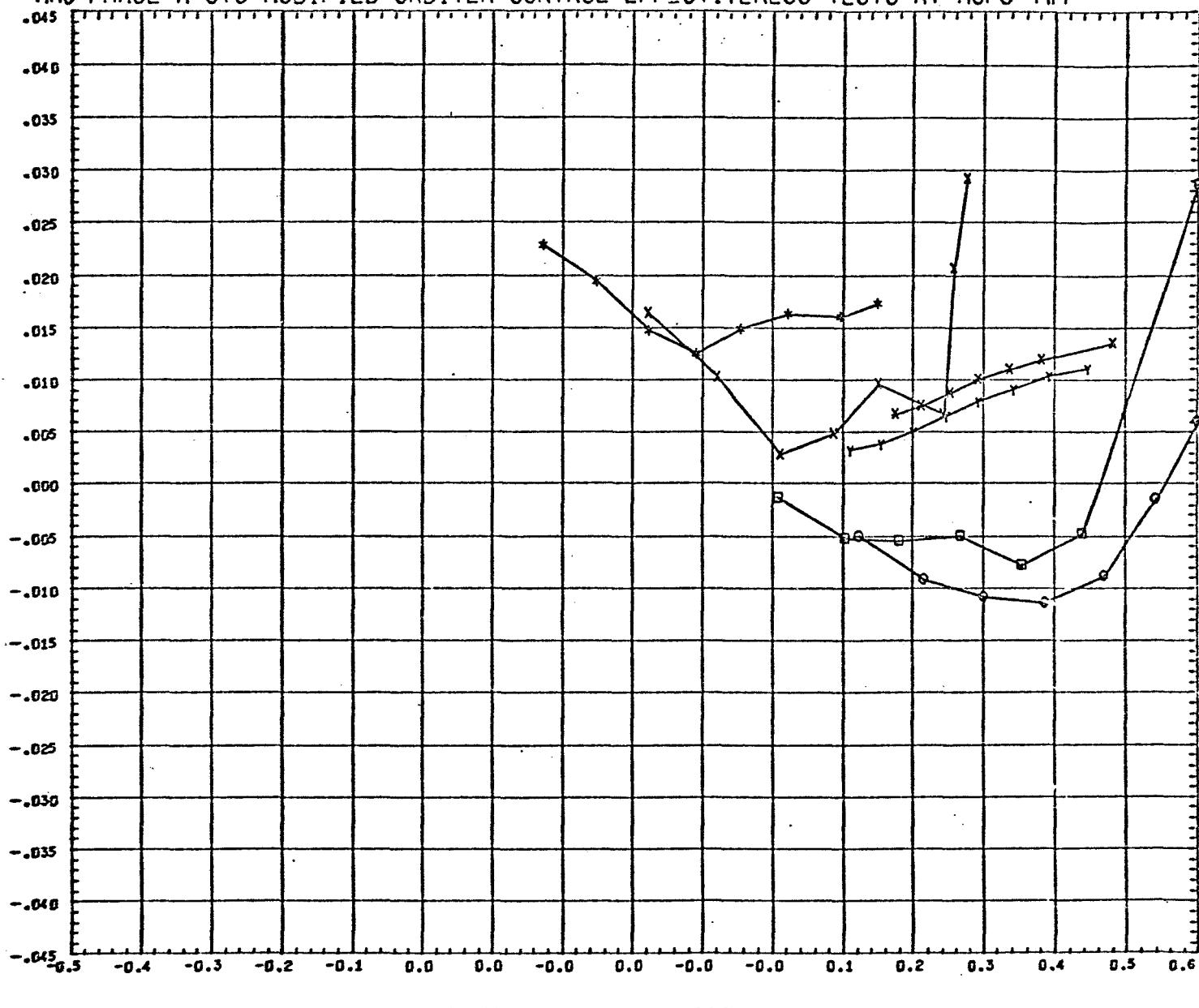
**REFERENCE FILE.**

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-15 R0

(S17028) 02 JUL 70 PAGE 170

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT. CNM



NORMAL FORCE COEFFICIENT. CN

SYMBOL	MACH	PARAMETRIC VALUES		
		BETA	0.000	ELEVON - 30.000
*	6.395	RUDER	0.000	
X	6.794			
Q	6.995			
O	1.198			
T	2.740			
X	3.479	REFERENCE FILE.		

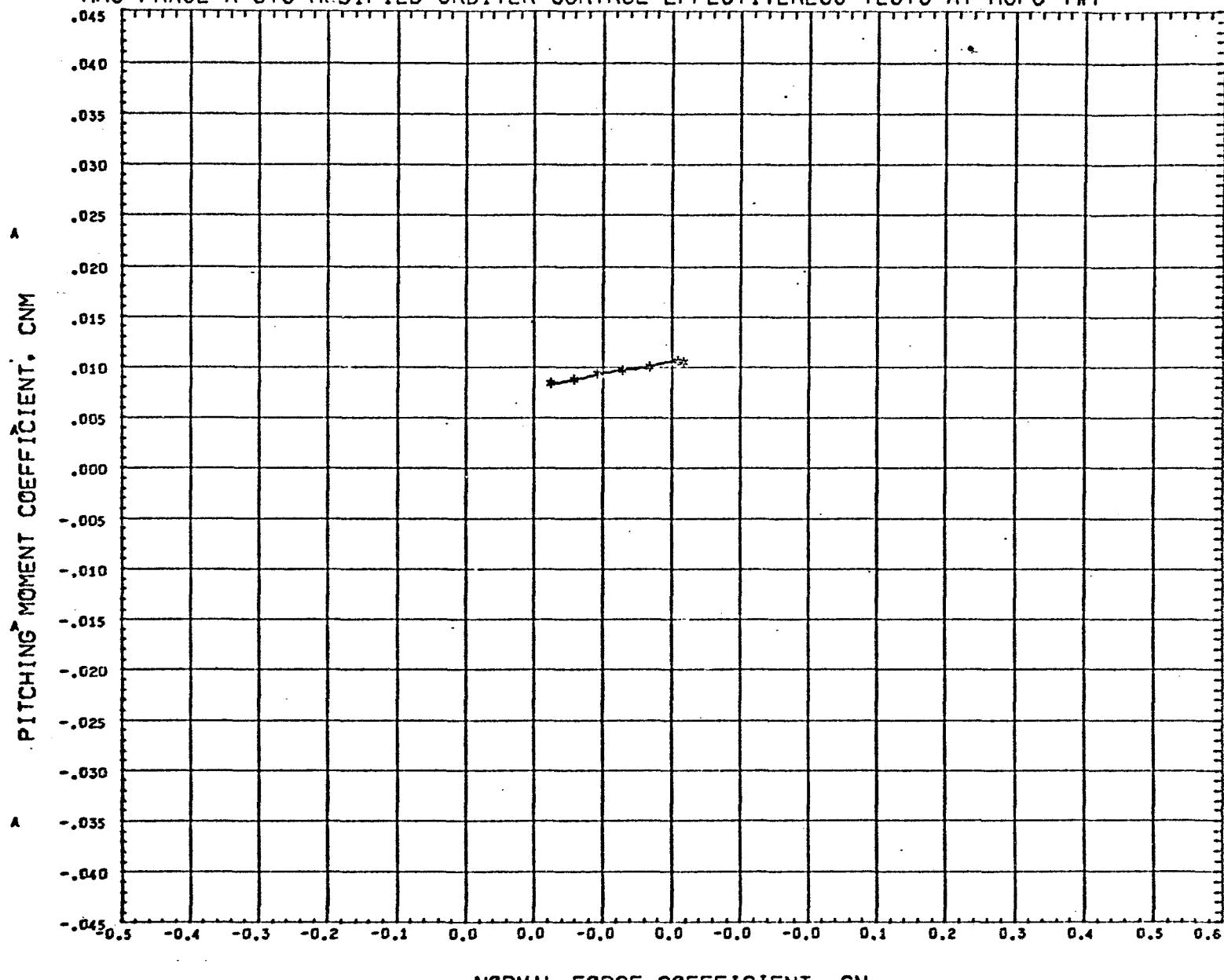
REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.600	
ZHRF	0.045	

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17029) 06 JUL 70

PAGE 171

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



NORMAL FORCE COEFFICIENT, CN

SYMBOL MACH PARAMETRIC VALUES  
 • 4.965 BETA 0.000 ELEVON - 30.000  
 RUDER 0.000

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

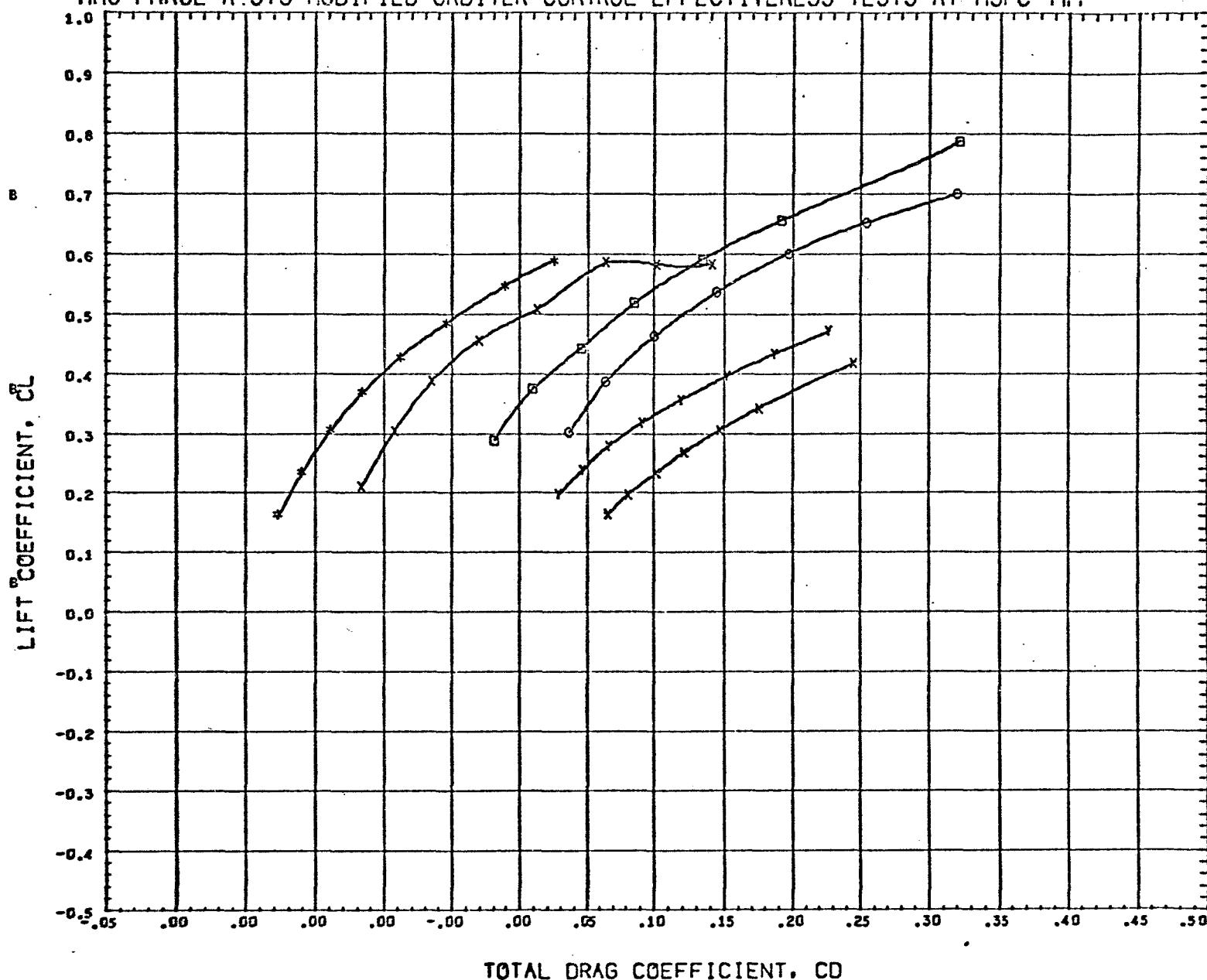
REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(R17029) 02 JUL 70

PAGE 172

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

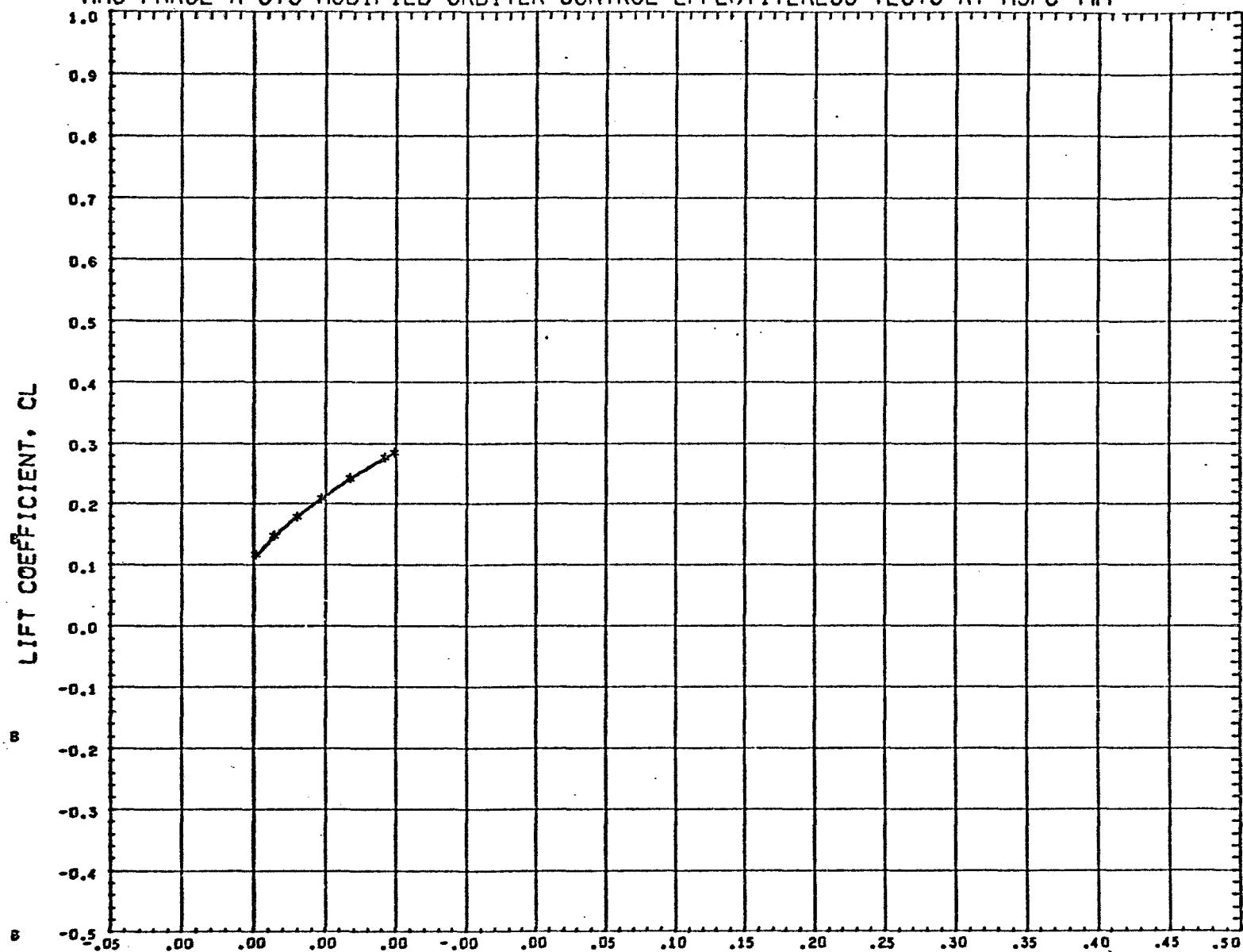


TOTAL DRAG COEFFICIENT, CD

SYMBOL	MACH	PARAMETRIC VALUES	
*	0.395	BETA	0.000
x	0.794	RUDER	0.000
o	0.995	ELEVON - 30,000	
◊	1.198		
▼	2.740		
▲	3.479	REFERENCE FILE.	

REFERENCE INFORMATION		
REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.495	FT.
XNRF	0.405	
YNRF	0.000	
ZNRF	0.045	

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT, CD

SYMBOL MACH. PARAMETRIC VALUES  
 \* 4.960 BETA 0.000 ELEVON - 30.000  
 RUDDER 0.000

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FY.  
 XMRF 0.406  
 YMRF 0.000  
 ZMRF 0.045

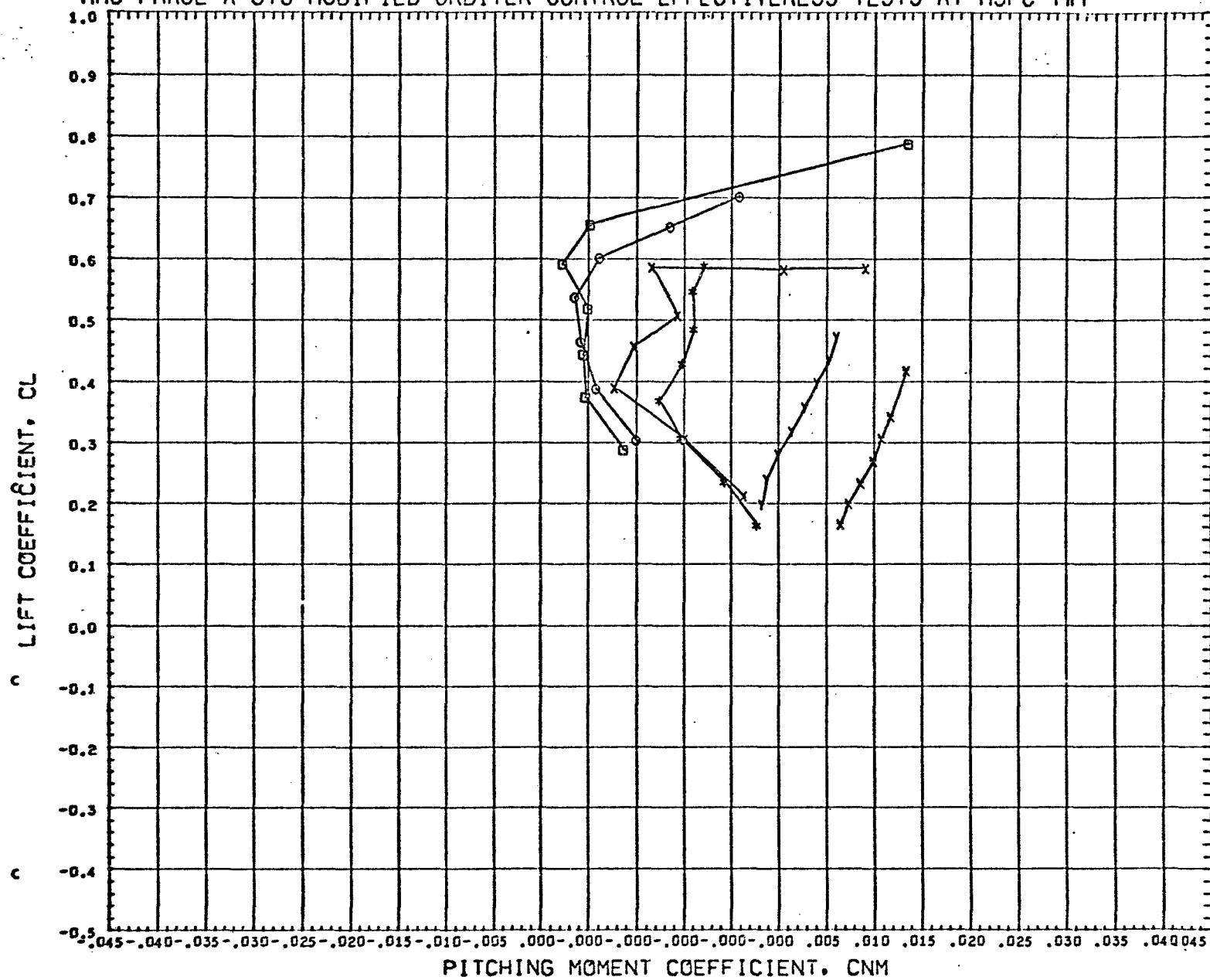
REFERENCE FILE.

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(S17029) 02 JUL 70

PAGE 174

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



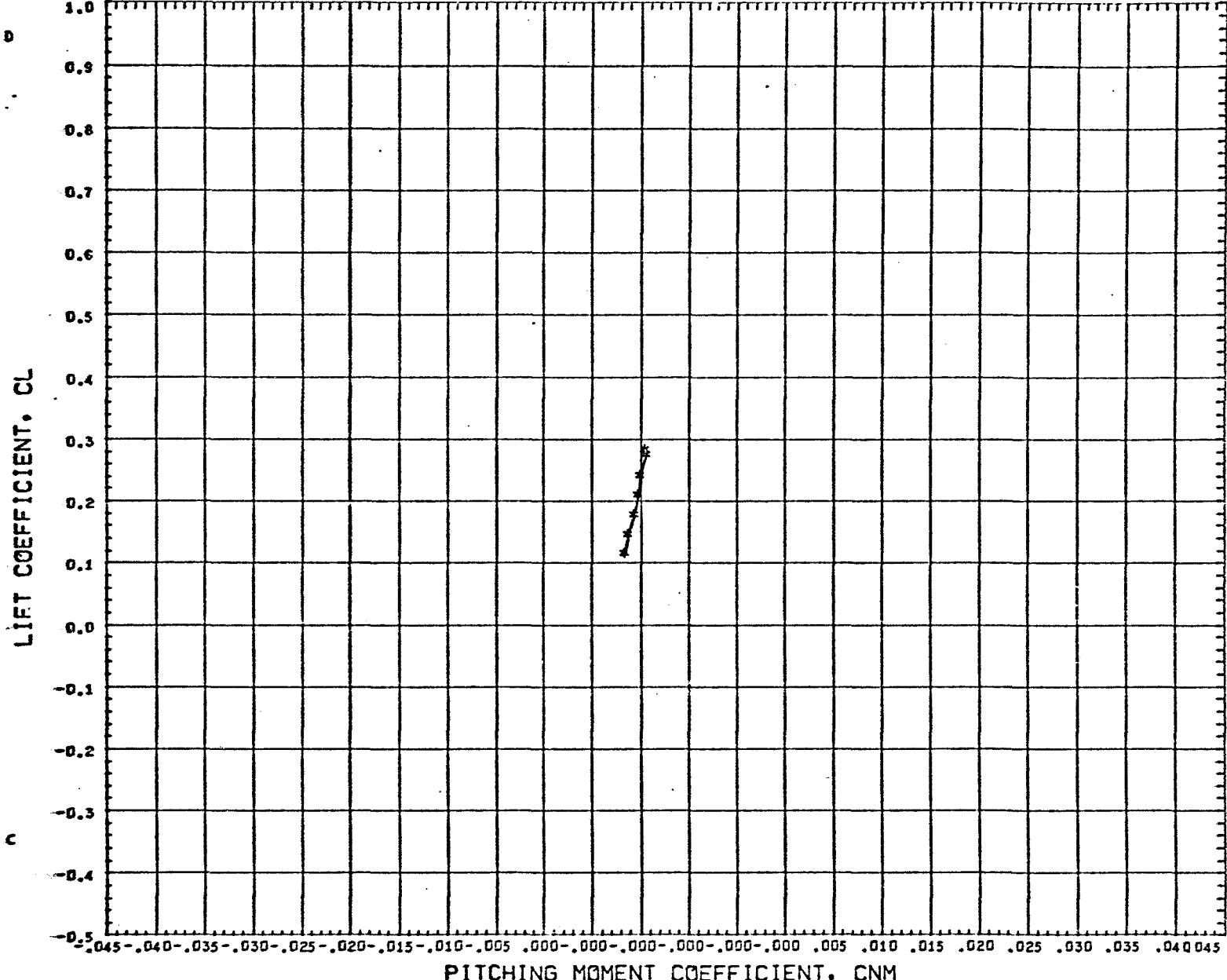
SYMBOL	MACH	PARAMETRIC VALUES		REFERENCE INFORMATION
		BETA	ELEVON	
*	0.395	0.000	- 30.000	REFS 0.116
x	0.794	RUDDER	0.000	REFL 0.646
o	0.995			REFB 0.405
o	1.198			XHRF 0.406
y	2.740			YHRF 0.000
x	3.479	REFERENCE FILE.		ZHRF 0.045

MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(S17029) 02 JUL 70

PAGE 175

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



REFERENCE FILE.

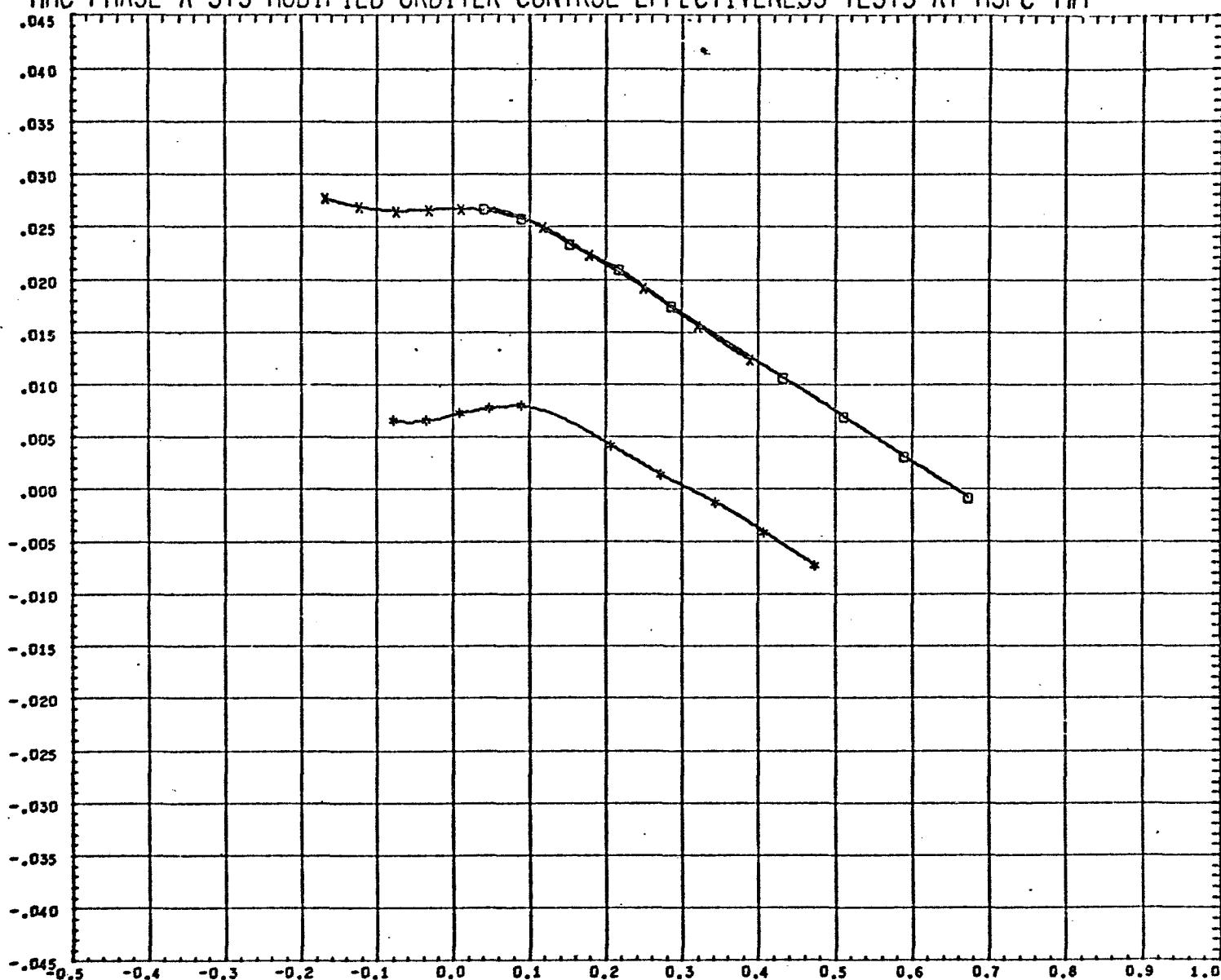
MSFC 453 MMC MOD ORB B2W2T1E1R1 DEL E-30 R0

(S17029) 02 JUL 70

PAGE 176

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



NORMAL FORCE COEFFICIENT, CN

SYMBOL CONFIGURATION DESCRIPTION

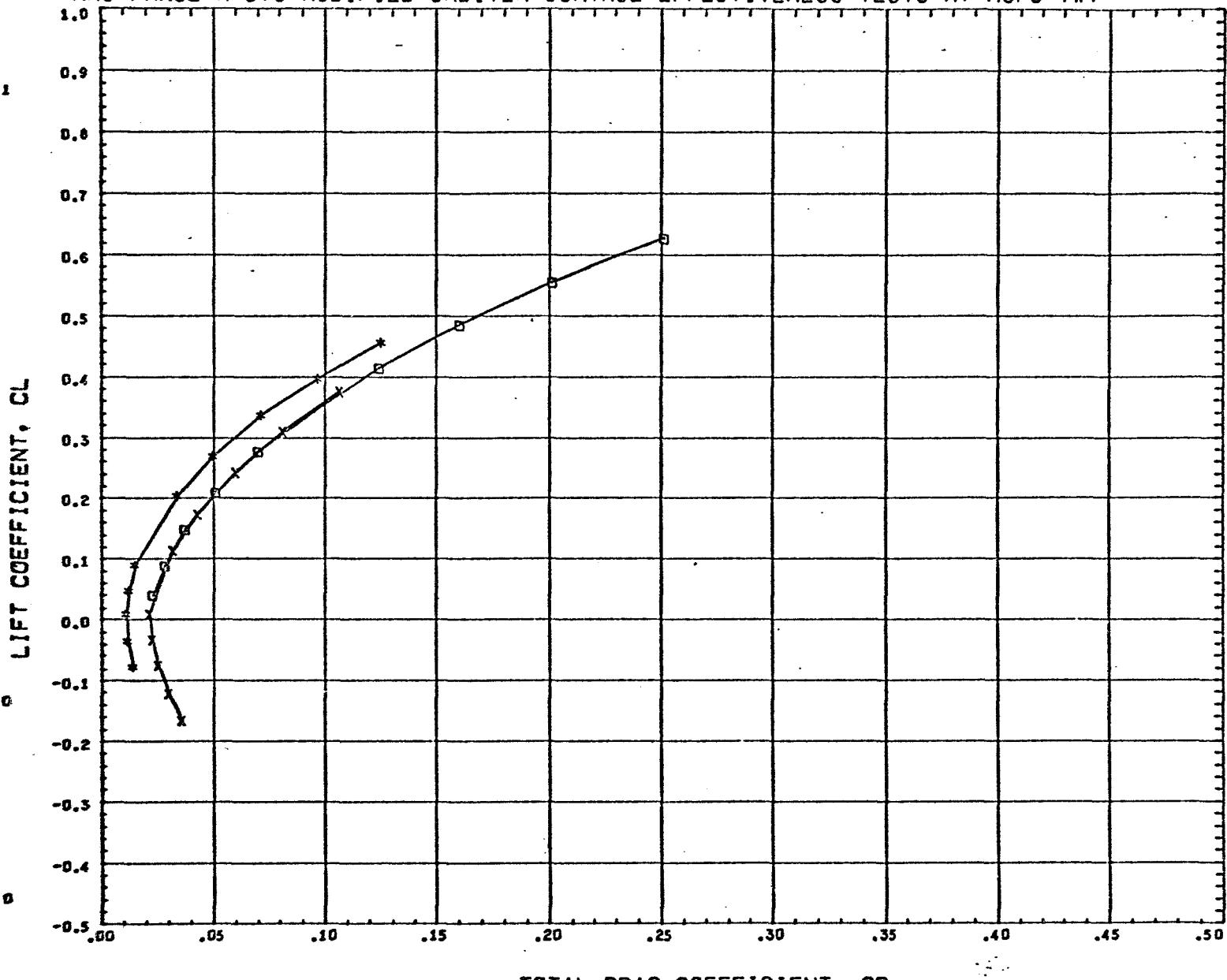
\* MSFC 453 MMC HOD ORB B2W2E1 DEL EG  
 X MSFC 453 MMC HOD ORB B2W2E1 E=-15  
 G MSFC 453 MMC HOD ORB B2W2E1 E=-15

DATA SET DATE MACH NUMBER  
 (B17021) 02 JUL 70 0.396  
 (B17022) 02 JUL 70  
 (B17023) 02 JUL 70

REFERENCE INFORMATION  
 REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFB 0.405 FT.  
 XMRF 0.406  
 YMRF 0.000  
 ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT, CD

SYMBOL CONFIGURATION DESCRIPTION

\* MSFC 453 MMC M00 ORB B2W2E1 DEL E0  
 X MSFC 453 MMC M00 ORB B2W2E1 E=-15  
 G MSFC 453 MMC M00 ORB B2W2E1 E=-15

DATA SET DATE MACH NUMBER

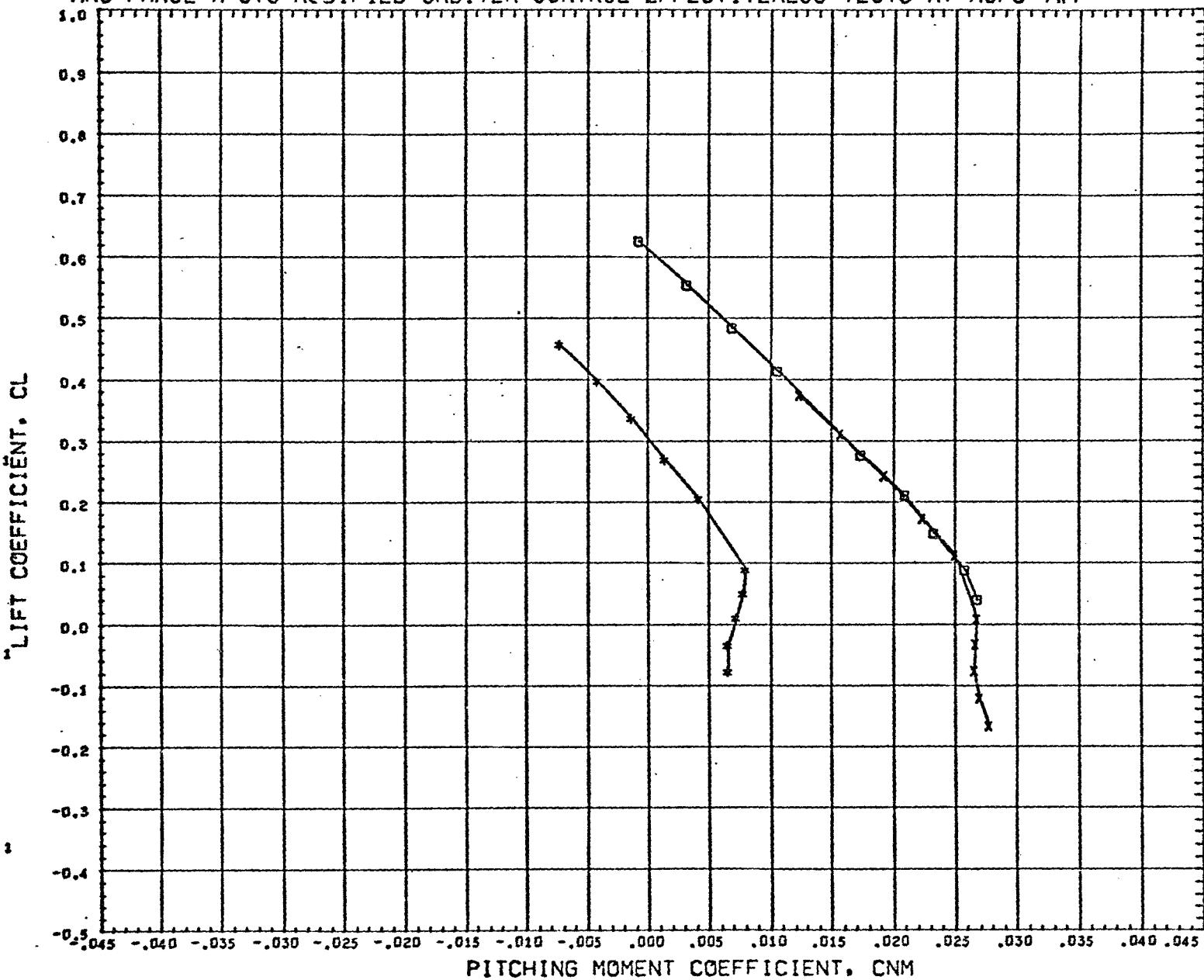
(S17021) 02 JUL 70 0.396  
 (T17022) 02 JUL 70  
 (T17023) 02 JUL 70

REFERENCE INFORMATION

REFS 0.116 SQ.FT.  
 REFL 0.646 FT.  
 REFb 0.405 FT.  
 XMRP 0.406  
 YMRF 0.600  
 ZNRF 0.045

REFERENCE FILE.

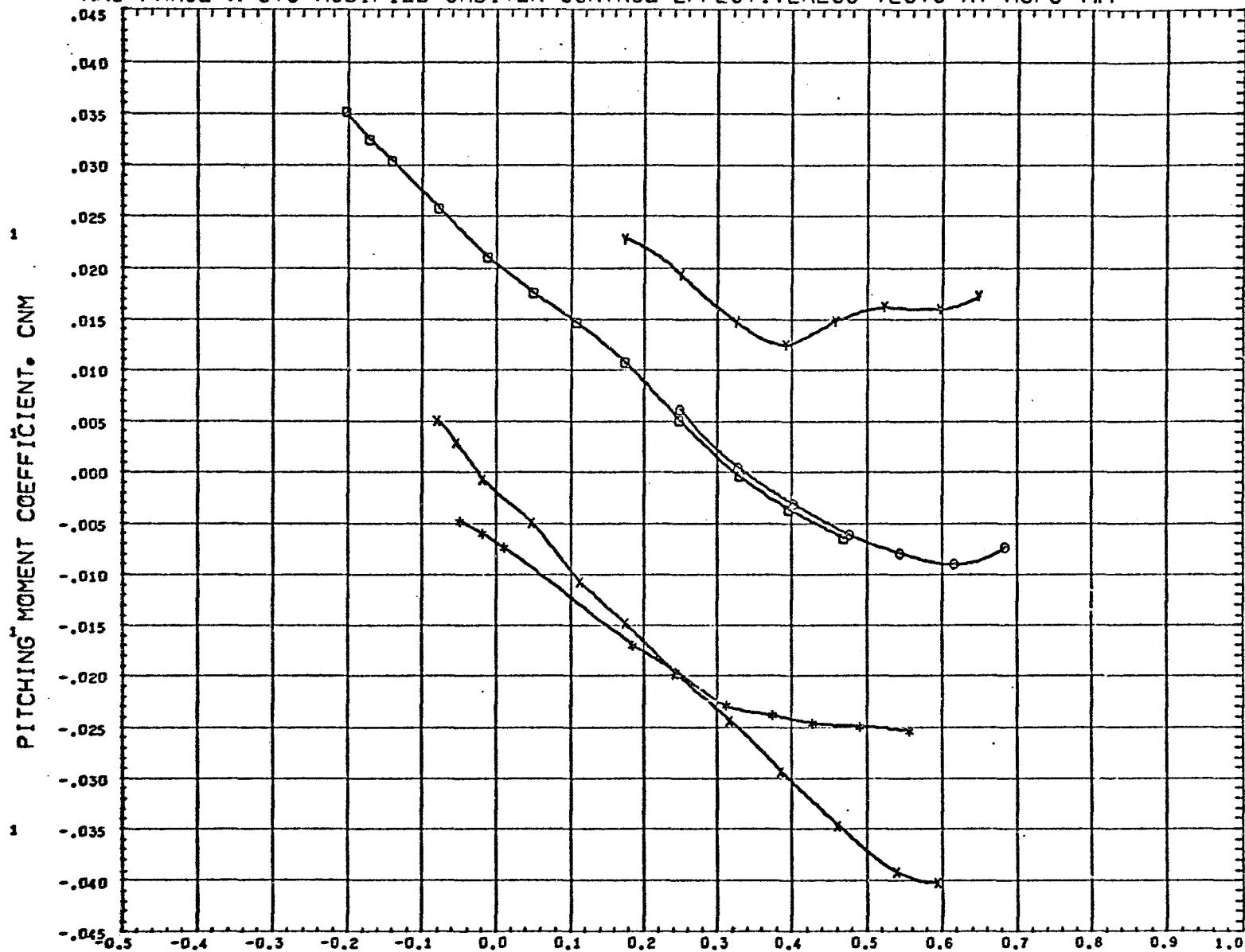
MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC M00 ORB B242E1 DEL E0	(S17021)	02 JUL 70	0.396	REFS 0.116 SQ.FT.
X	MSFC 453 MMC M00 ORB B2W2E1 E=-15	(T17022)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC M00 ORB B2W2E1 E=-15	(T17023)	02 JUL 70		REFB 0.405 FT. XHRF 0.406 YHRF 0.000 ZHRF 0.045

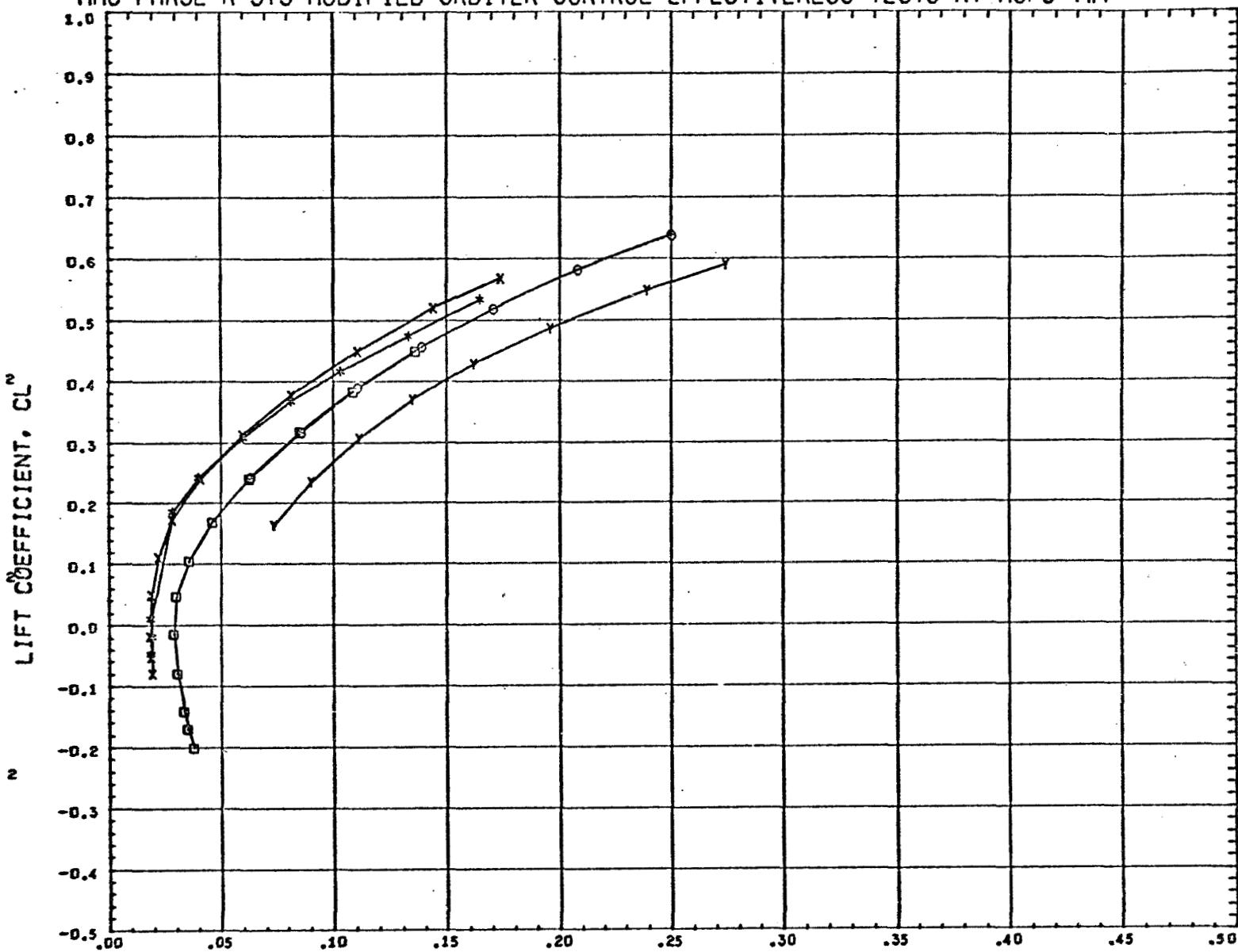
REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

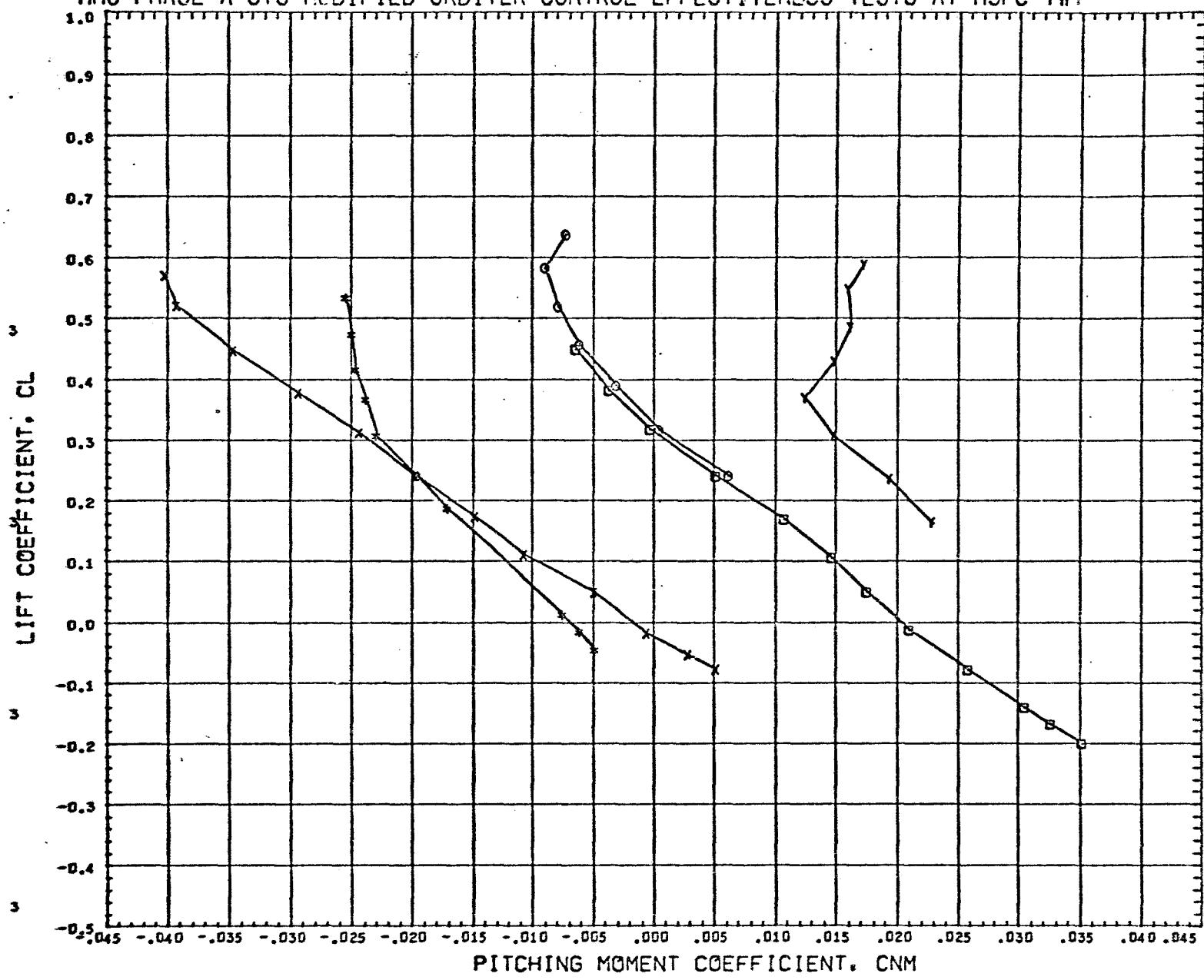


TOTAL DRAG COEFFICIENT, CD

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 HMC M00 ORB B2W2T1R1 E=OFF	(T17024)	02 JUL 70	0.398	REFS 0.116 SQ.FT.
X	MSFC 453 HMC M00 ORB B2W2T1E1R1 E=0	(T17025)	02 JUL 70	0.398	REFL 0.646 FT.
G	MSFC 453 HMC M00 ORB B2W2T1E1R1 E=-15	(T17026)	02 JUL 70	0.398	REFB 0.405 FT.
G	MSFC 453 HMC M00 ORB B2W2T1E1R1 E=-15	(T17028)	02 JUL 70	0.398	XHRF 0.406
Y	MSFC 453 HMC M00 ORB B2W2T1E1R1 E=-30	(T17029)	02 JUL 70	0.398	YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

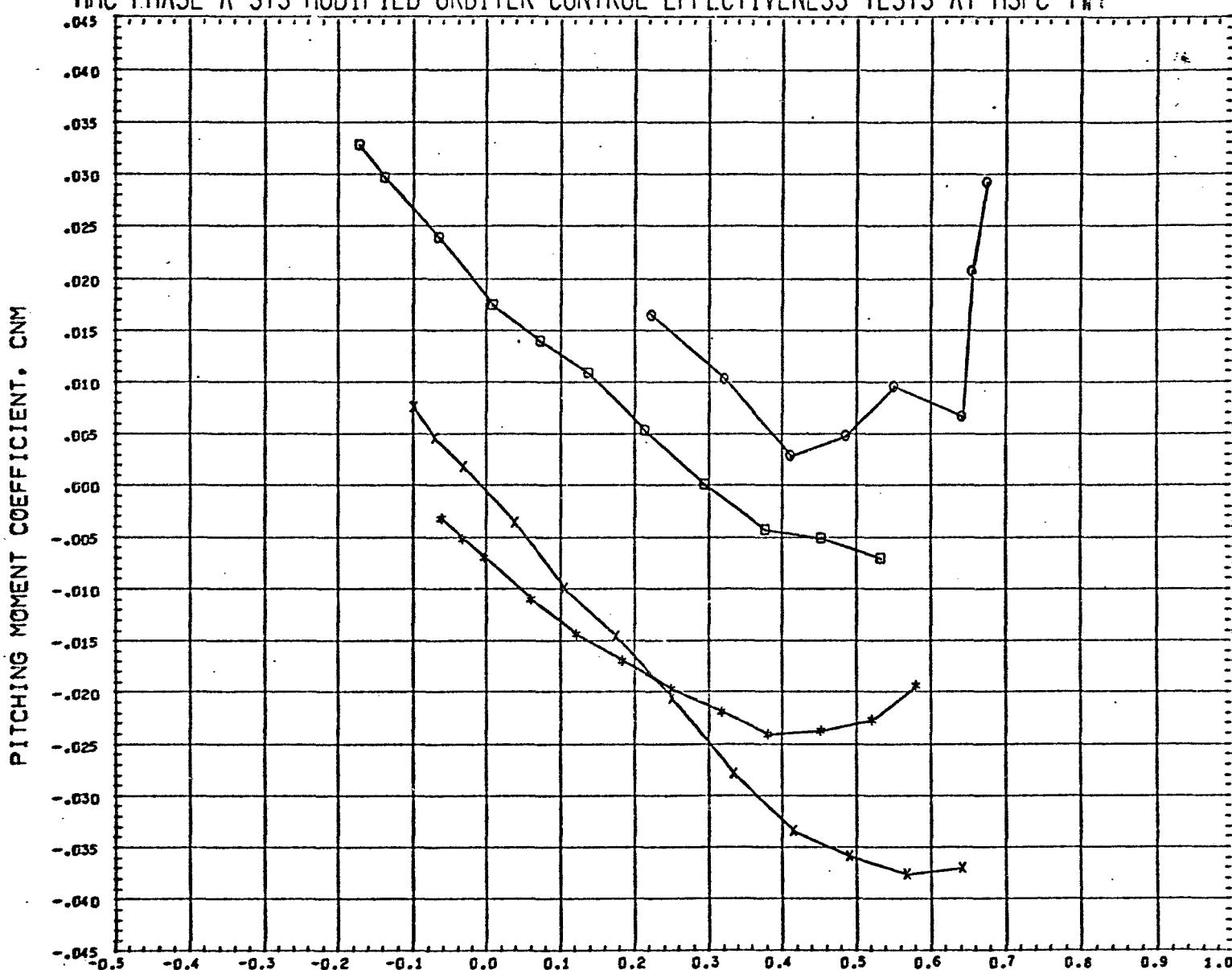
MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(T17024)	02 JUL 70	0.398	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(T17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(T17026)	02 JUL 70		REFB 0.405 FT.
O	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(T17028)	02 JUL 70		XMRP 0.406
Y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(T17029)	02 JUL 70		YMRP 0.000
Z					ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

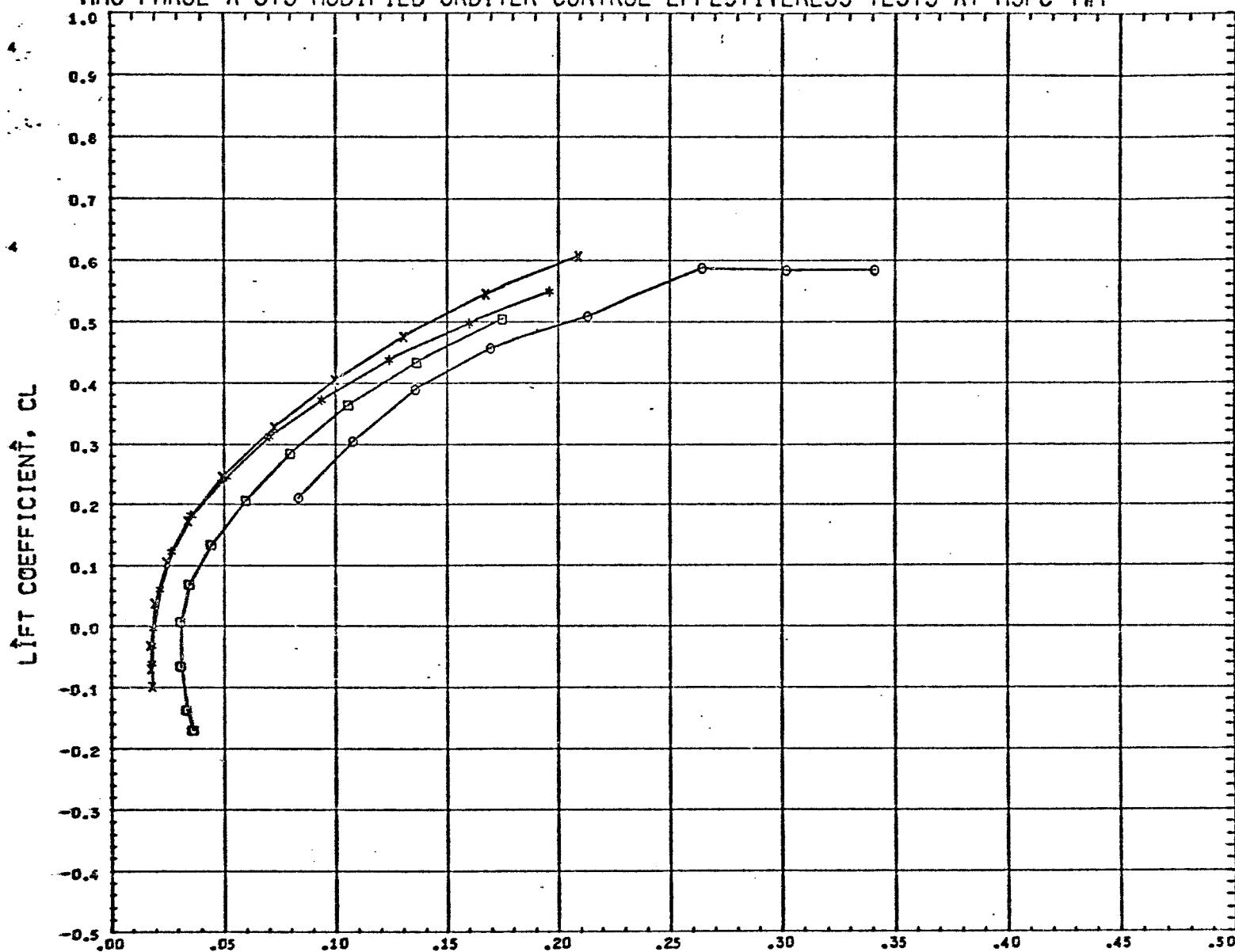


NORMAL FORCE COEFFICIENT, CN

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MCD ORB B2W2T1R1 E=OFF	(C17024)	06 JUL 70	0.797	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=0	(C17025)	06 JUL 70		REFL 0.646 FT.
Q	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-15	(C17026)	06 JUL 70		REFB 0.405 FT.
O	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-30	(C17029)	06 JUL 70		XHRF 0.406
					YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

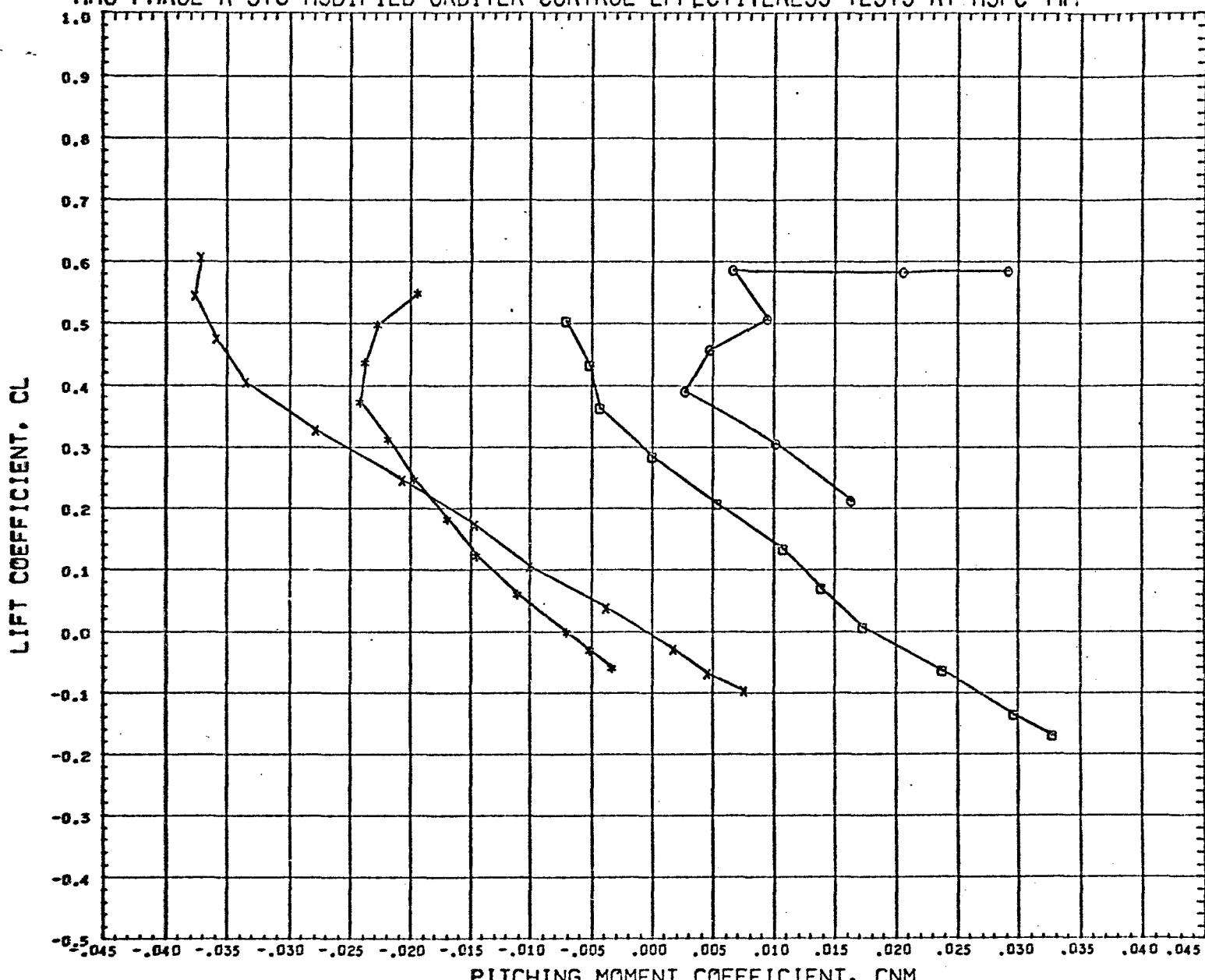


TOTAL DRAG COEFFICIENT, CD

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC HOD ORB B2W2T1R1 E=OFF	(U17024)	02 JUL 70	0.797	REFS 0.116 SQ.FT.
X	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=0	(U17025)	02 JUL 70	0.797	REFL 0.646 FT.
G	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=-15	(U17026)	02 JUL 70	0.797	REFB 0.405 FT.
G	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=-30	(U17029)	02 JUL 70	0.797	XHRF 0.406 YHRF 0.000 ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

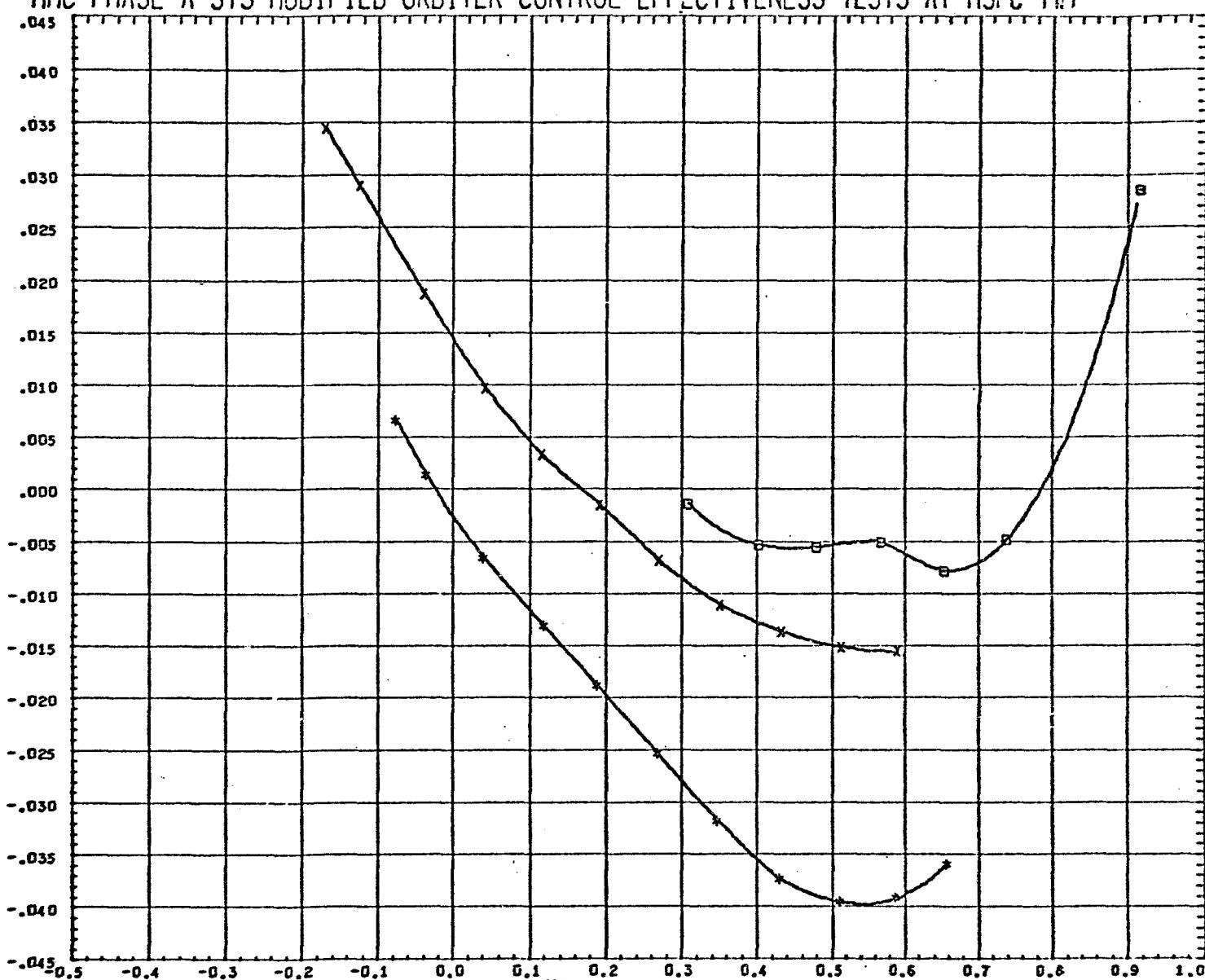


SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MCG ORB B2W2T1R1 E=OFF	(U17024)	02 JUL 70	0.797	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MCG ORB B2W2T1E1R1 E=0	(U17025)	02 JUL 70	0.797	REFL 0.646 FT.
o	MSFC 453 MMC MCG ORB B2W2T1E1R1 E=-15	(U17026)	02 JUL 70	0.797	REFB 0.405 FT.
o	MSFC 453 MMC MCG ORB B2W2T1E1R1 E=-30	(U17029)	02 JUL 70	0.797	XMRP 0.406
					YMRP 0.000
					ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT. CNM



NORMAL FORCE COEFFICIENT. CN

SYMBOL CONFIGURATION DESCRIPTION

- \* MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0
- X MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15
- G MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30

DATA SET DATE MACH NUMBER

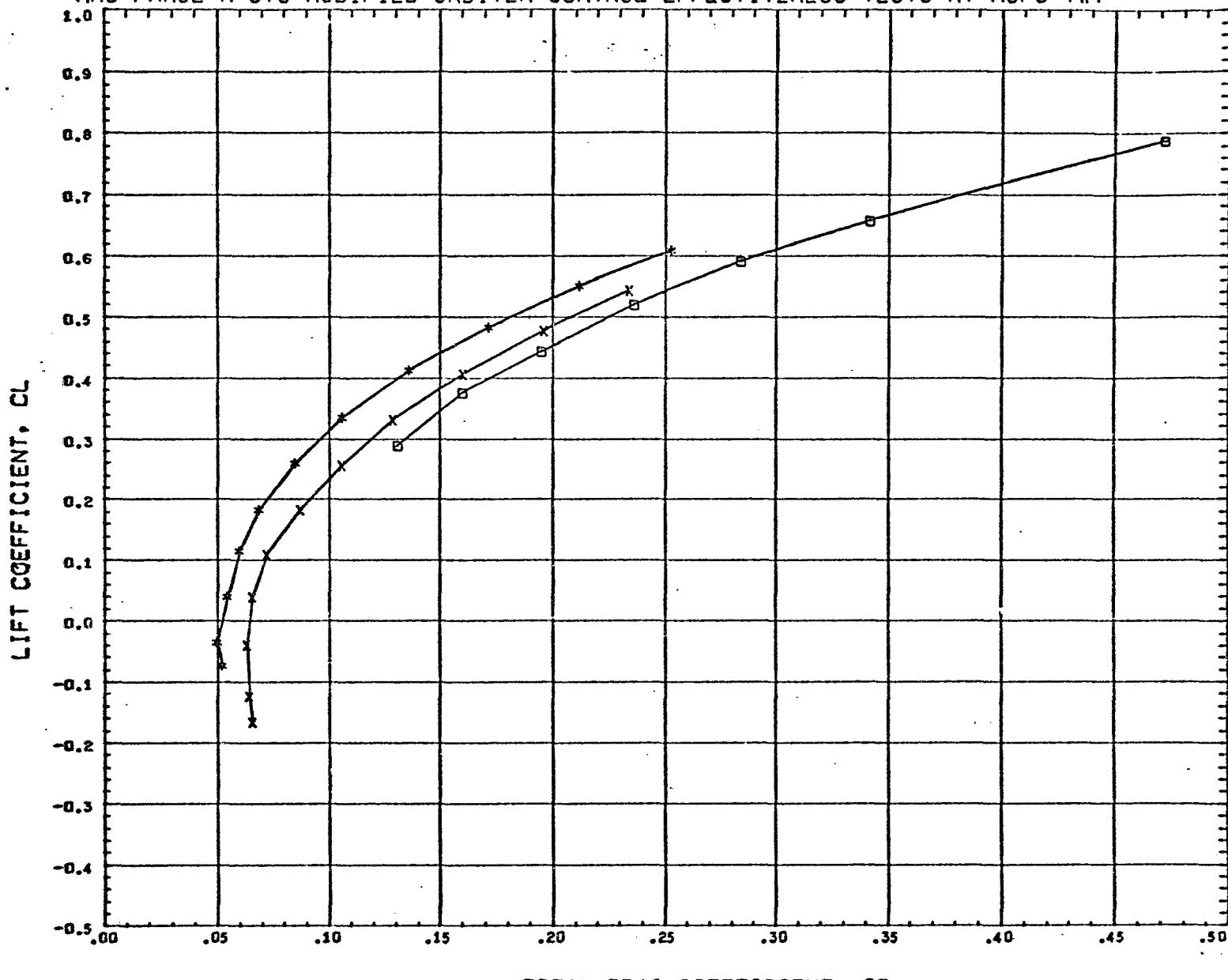
- (D17025) 02 JUL 70 0.996
- (D17026) 02 JUL 70
- (D17029) 02 JUL 70

REFERENCE INFORMATION

REFS	0.116	SQ.FT.
REFL	0.646	FT.
REFB	0.405	FT.
XHRF	0.406	
YHRF	0.000	
ZHRF	0.045	

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

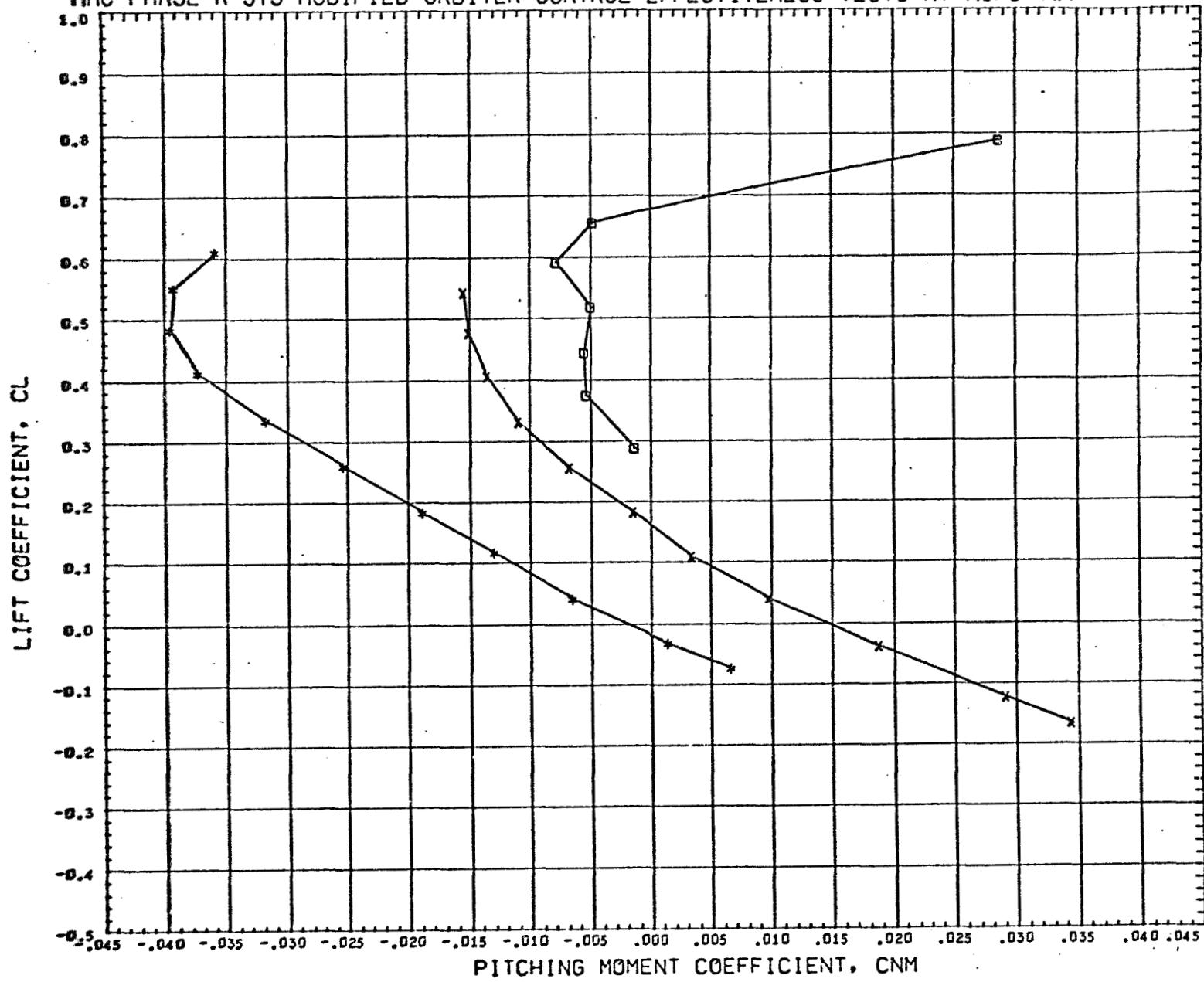


TOTAL DRAG COEFFICIENT, CD

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=0	(V17025)	02 JUL 70	0.996	REFS 0.116 SQ.FT.
x	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-15	(V17026)	02 JUL 70	0.996	REFL 0.646 FT.
□	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-30	(V17029)	02 JUL 70	0.996	REFB 0.405 FT. XHRF 0.406 YHRP 0.000 ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



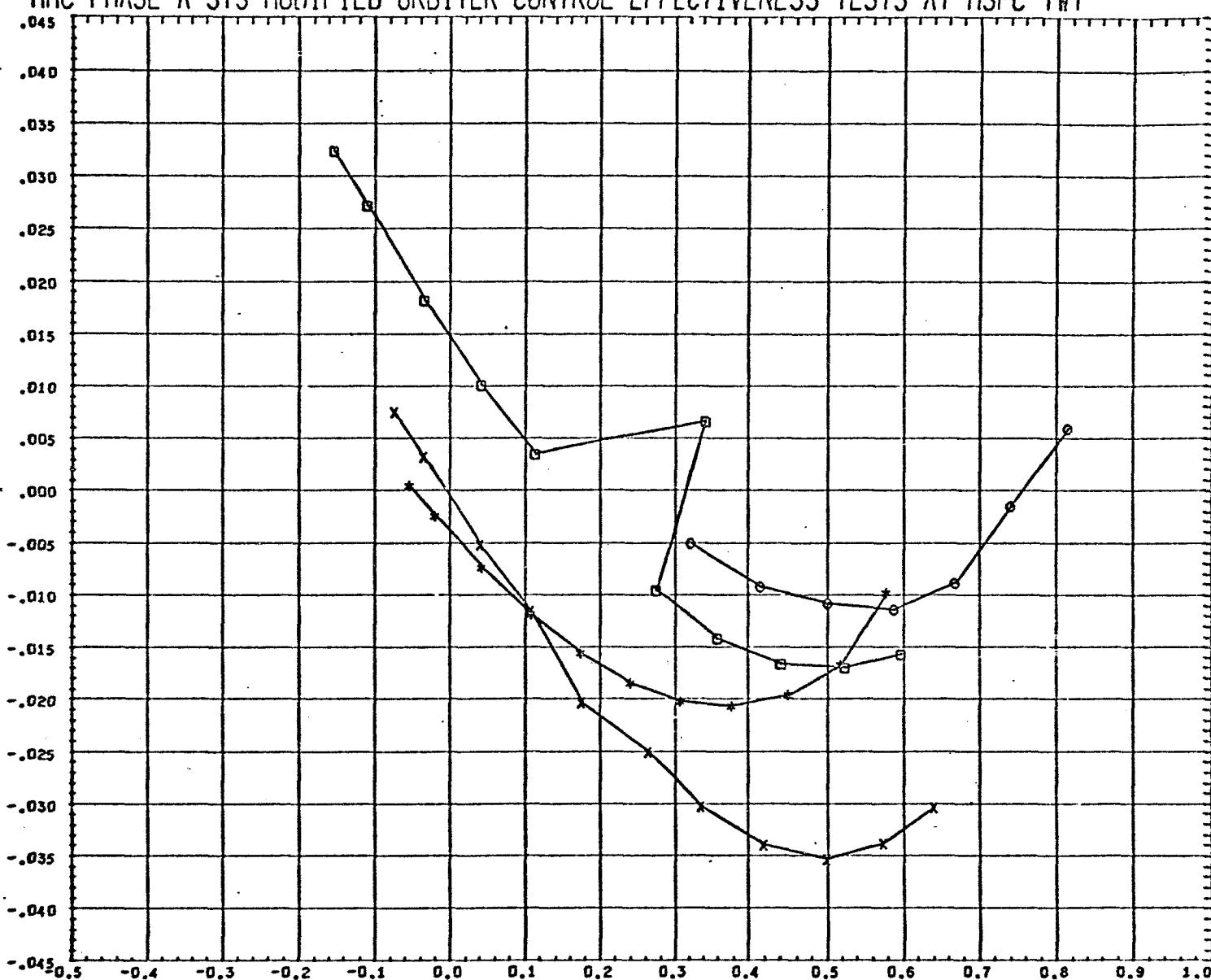
SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=0	(V17025)	02 JUL 70	0.996	RFS 0.116 SO.FT.
X	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-15	(V17026)	02 JUL 70	0.996	REFL 0.646 FT.
O	MSFC 453 MMC MCD ORB B2W2T1E1R1 E=-30	(V17029)	02 JUL 70	0.996	REFB 0.405 FT.

REFERENCE FILE.

PAGE 188

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM



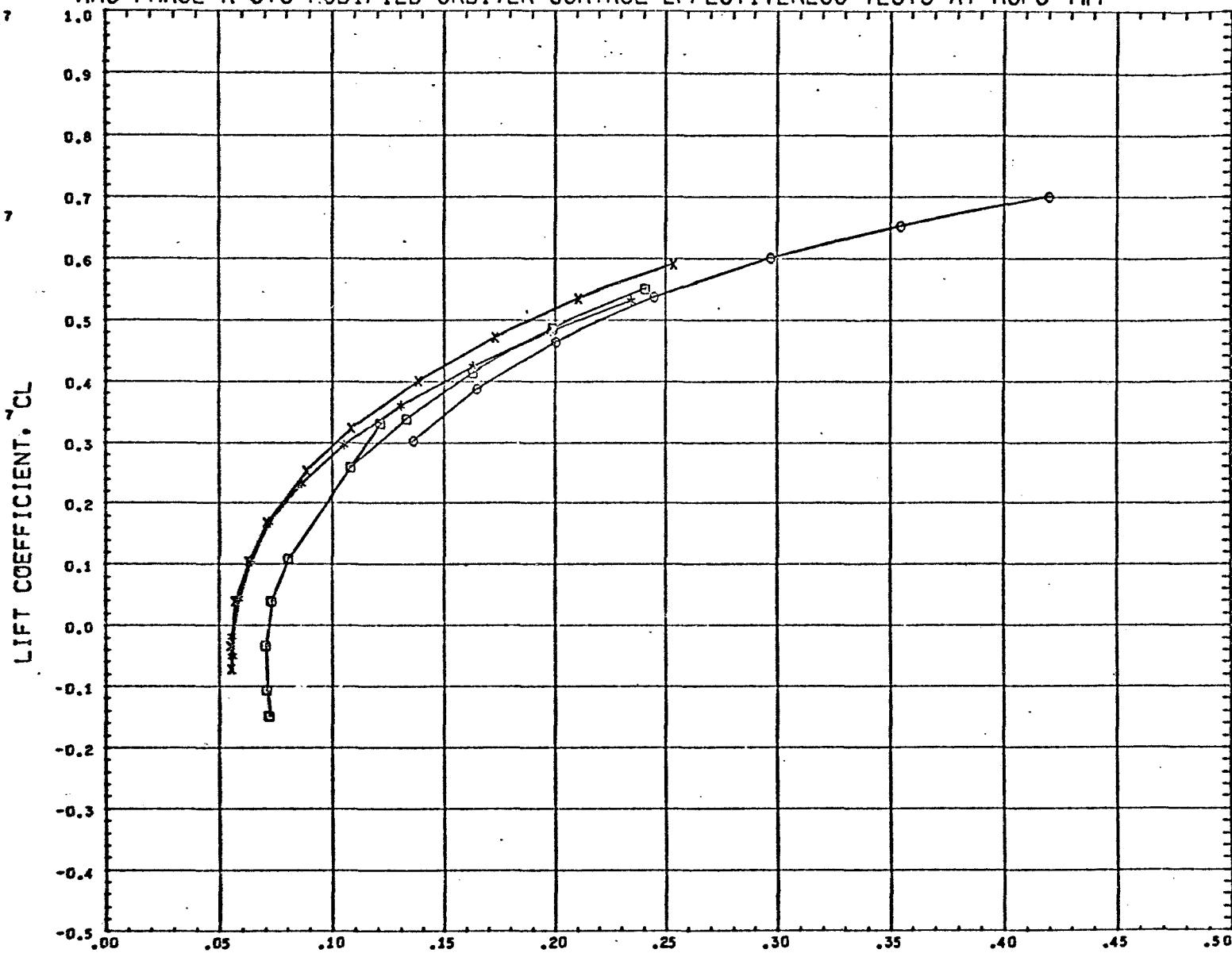
NORMAL FORCE COEFFICIENT, CN

SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MMC MOD CRS B2W2T1R1 E=OFF
x	MSFC 453 MMC MOD CRS B2W2T1E1R1 E=0
◻	MSFC 453 MMC MOD CRS B2W2T1E1R1 E=-15
○	MSFC 453 NMC MOD CRS B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
(E17024)	02 JUL 70	1.199	REFS 0.116 SQ.FT.
(E17025)	02 JUL 70		REFL 0.646 FT.
(E17026)	02 JUL 70		REFB 0.405 FT.
(E17029)	02 JUL 70		XNRF 0.406
			YNRF 0.000
			ZNRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



TOTAL DRAG COEFFICIENT. CD

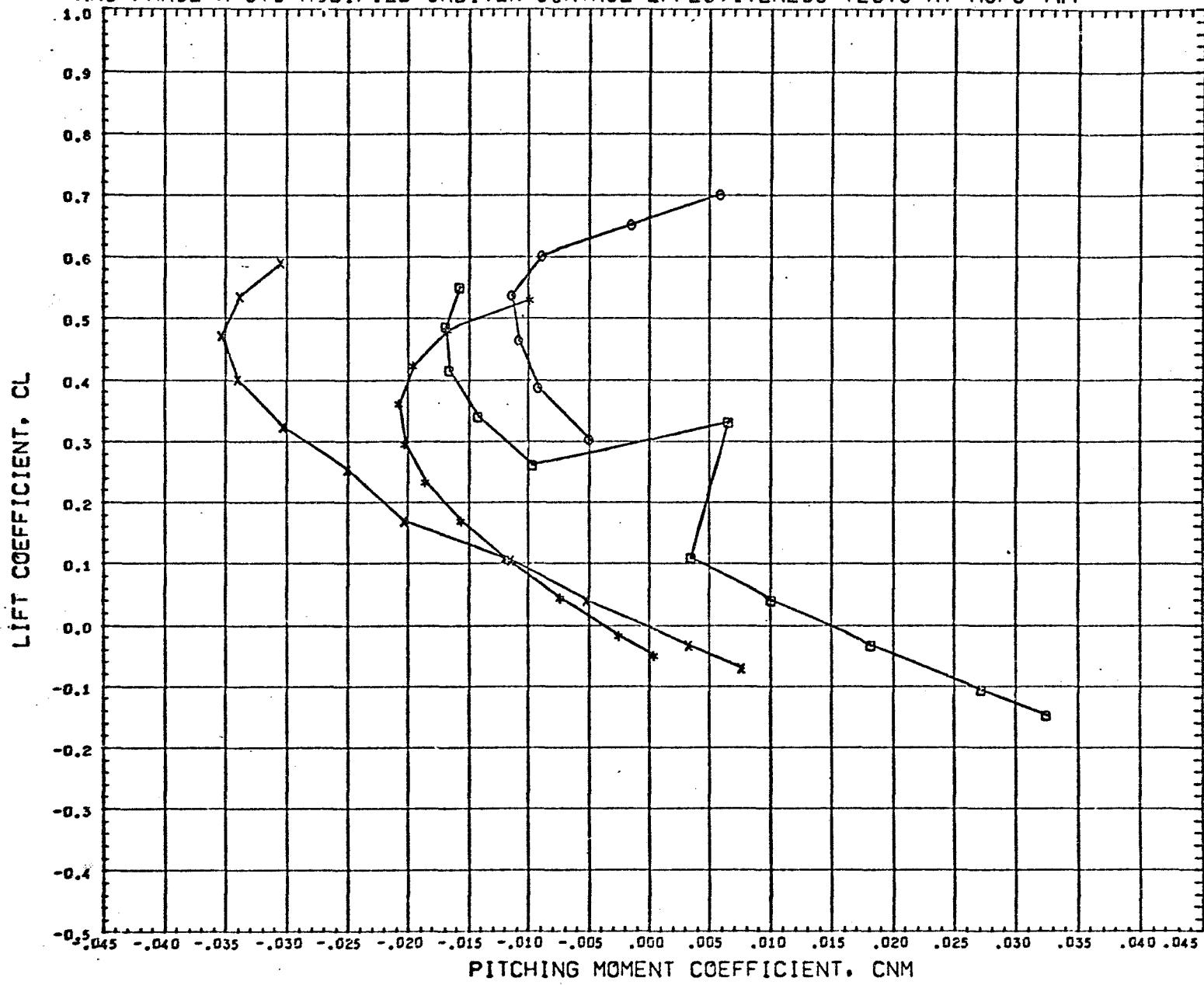
SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MHC MOD ORB B2W2T1R1 E=OFF
x	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=0
o	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-15
●	MSFC 453 MHC MOD ORB B2W2T1E1R1 E=-30

DATA SET	DATE	MACH NUMBER
(W17024)	02 JUL 70	1.199
(W17025)	02 JUL 70	
(W17026)	02 JUL 70	
(W17029)	02 JUL 70	

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XHRF 0.406
YHRF 0.000
ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



PITCHING MOMENT COEFFICIENT, CNM

SYMBOL	CONFIGURATION DESCRIPTION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15
O	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30

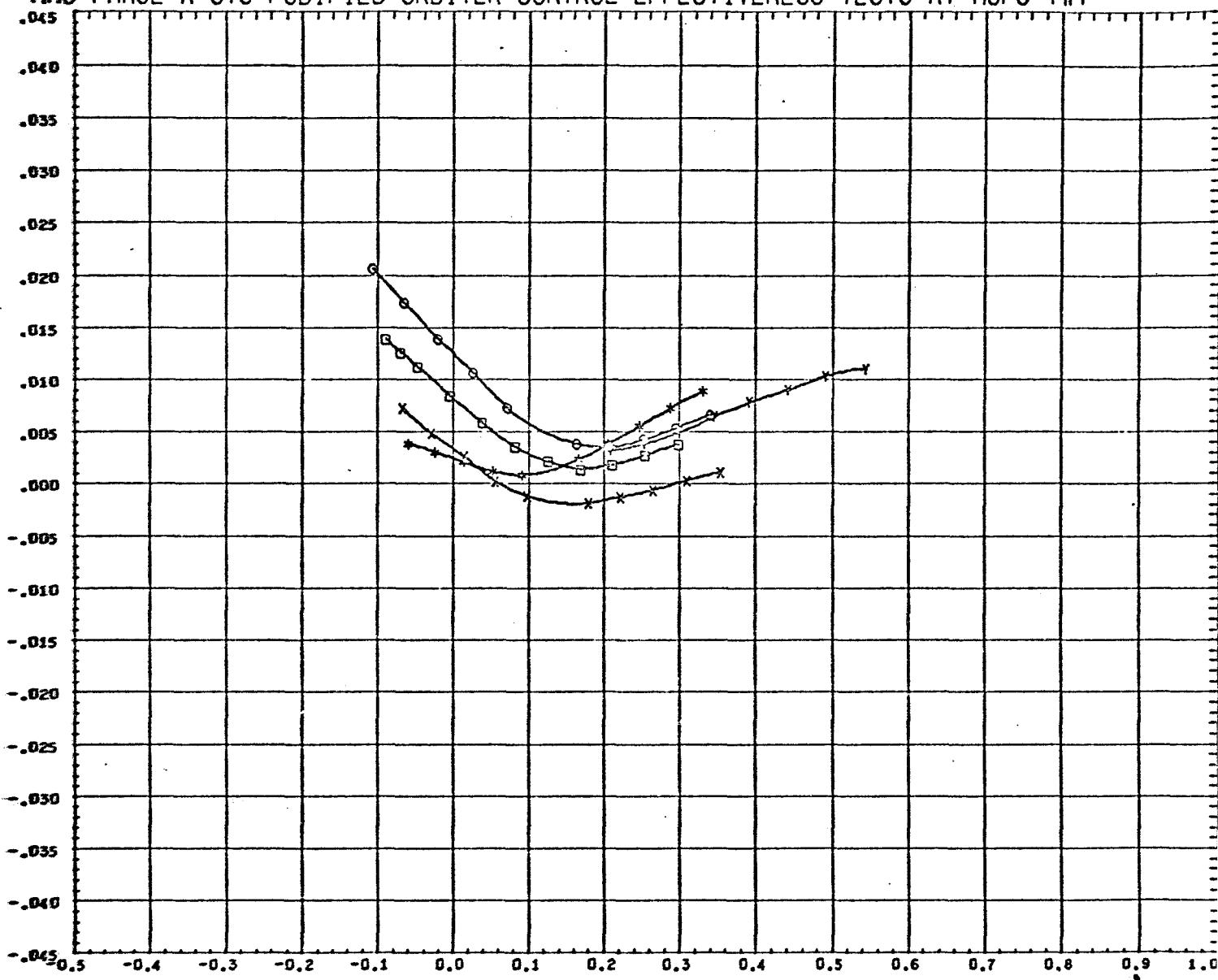
DATA SET	DATE	MACH NUMBER
(W17024)	02 JUL 70	1.199
(W17025)	02 JUL 70	
(W17026)	02 JUL 70	
(W17029)	02 JUL 70	

REFERENCE INFORMATION
REFS 0.116 SQ.FT.
REFL 0.646 FT.
REFB 0.405 FT.
XMRF 0.496
YMRF 0.000
ZMRF 0.645

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM

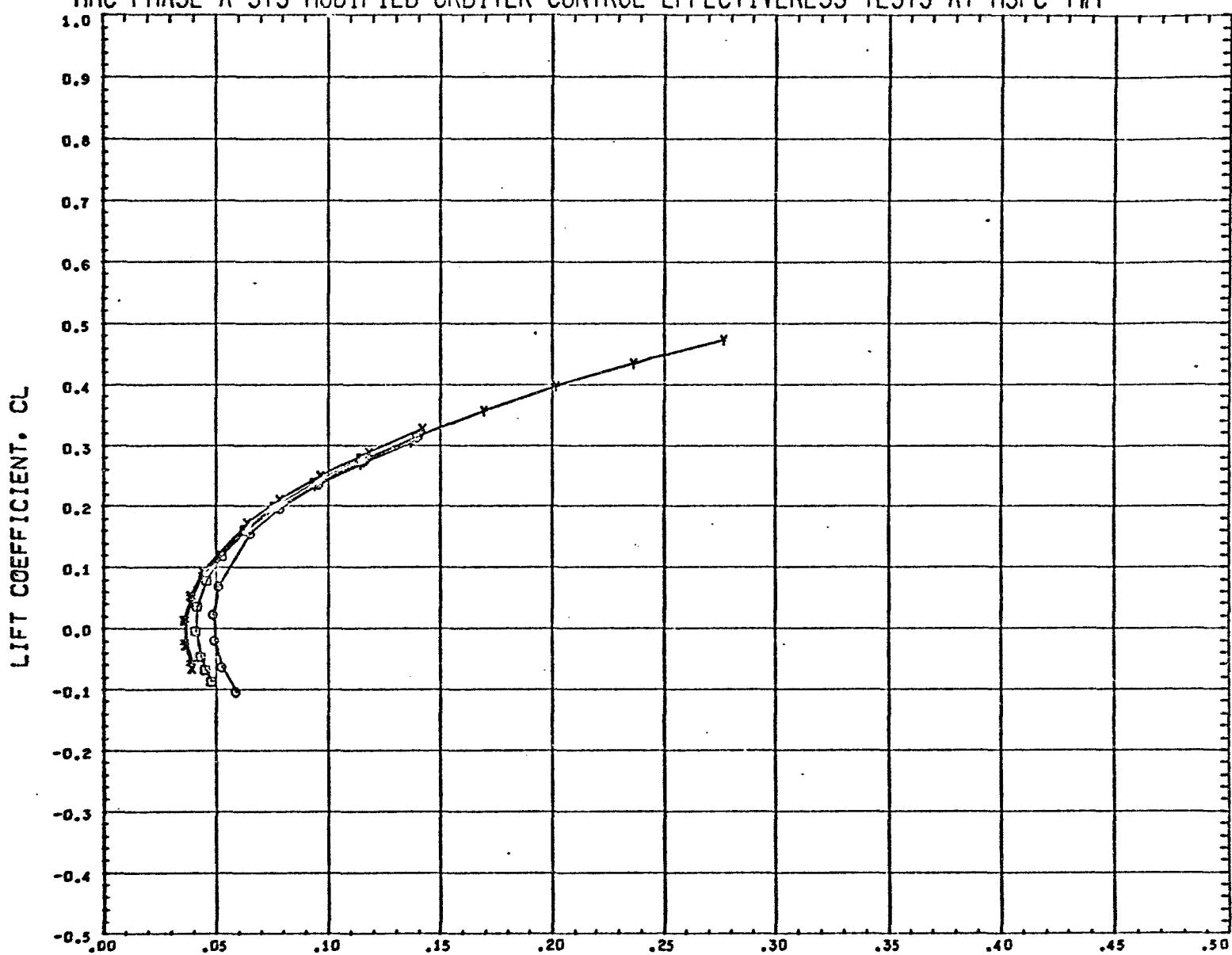


NORMAL FORCE COEFFICIENT, CN

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 HMC HOD GRB S2W2T1E1R1 E=OFF	(F17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
X	MSFC 453 HMC HOD GRB S2W2T1E1R1 E=0	(F17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 HMC HOD GRB S2W2T1E1R1 E=-15	(F17026)	02 JUL 70		REFB 0.405 FT.
O	MSFC 453 HMC HOD GRB S2W2T1E1R1 E=-30	(F17027)	02 JUL 70		XMRF 0.406
Y	MSFC 453 HMC HOD GRB S2W2T1E1R1 E=-30	(F17029)	02 JUL 70		YMRF 0.000
					ZMRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

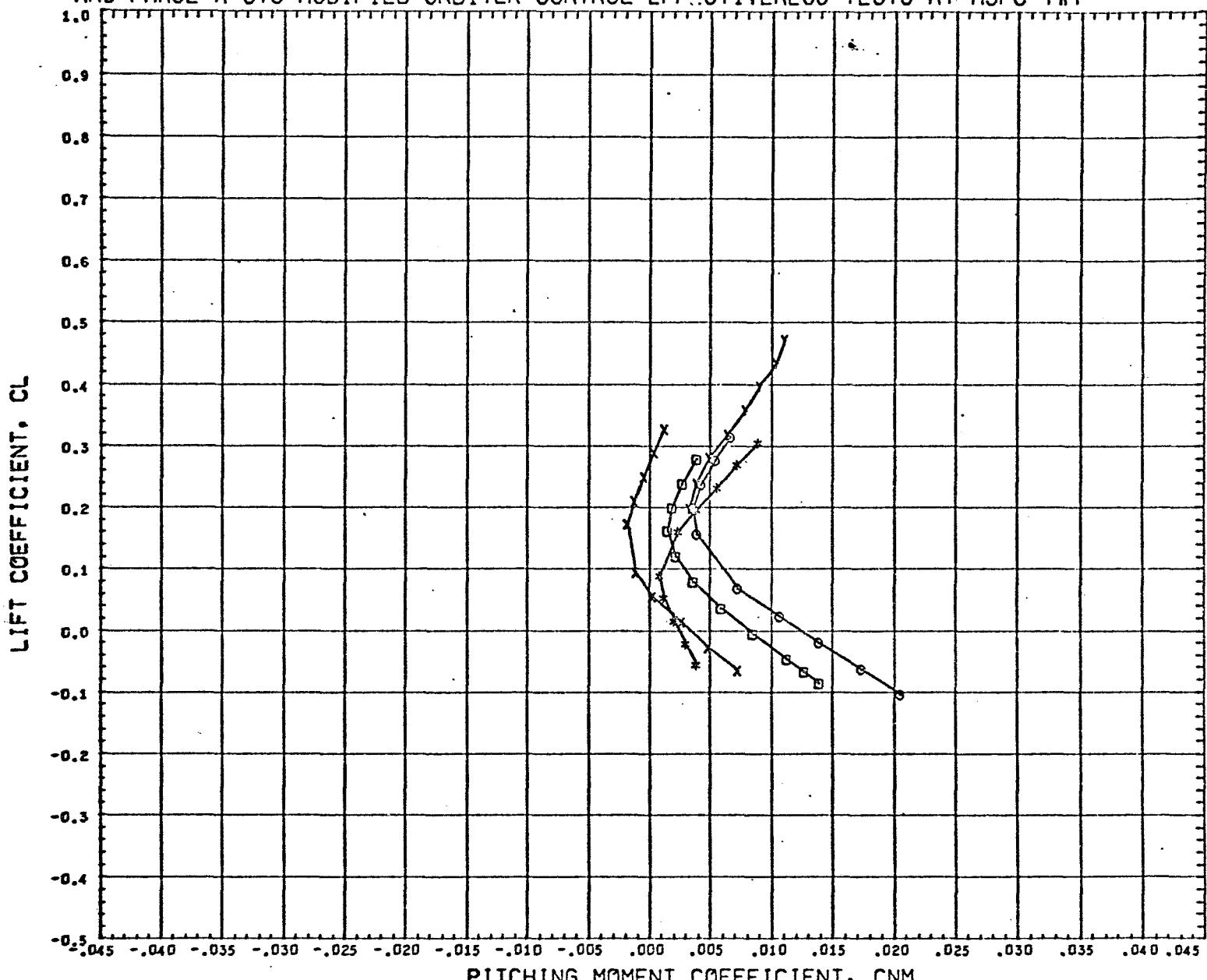


TOTAL DRAG COEFFICIENT, CD

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(X17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(X17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(X17026)	02 JUL 70		REFB 0.405 FT.
C	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(X17027)	02 JUL 70		XHRF 0.406
Y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(X17029)	02 JUL 70		YHRF 0.000
					ZHRP 0.045

REFERENCE FILE.

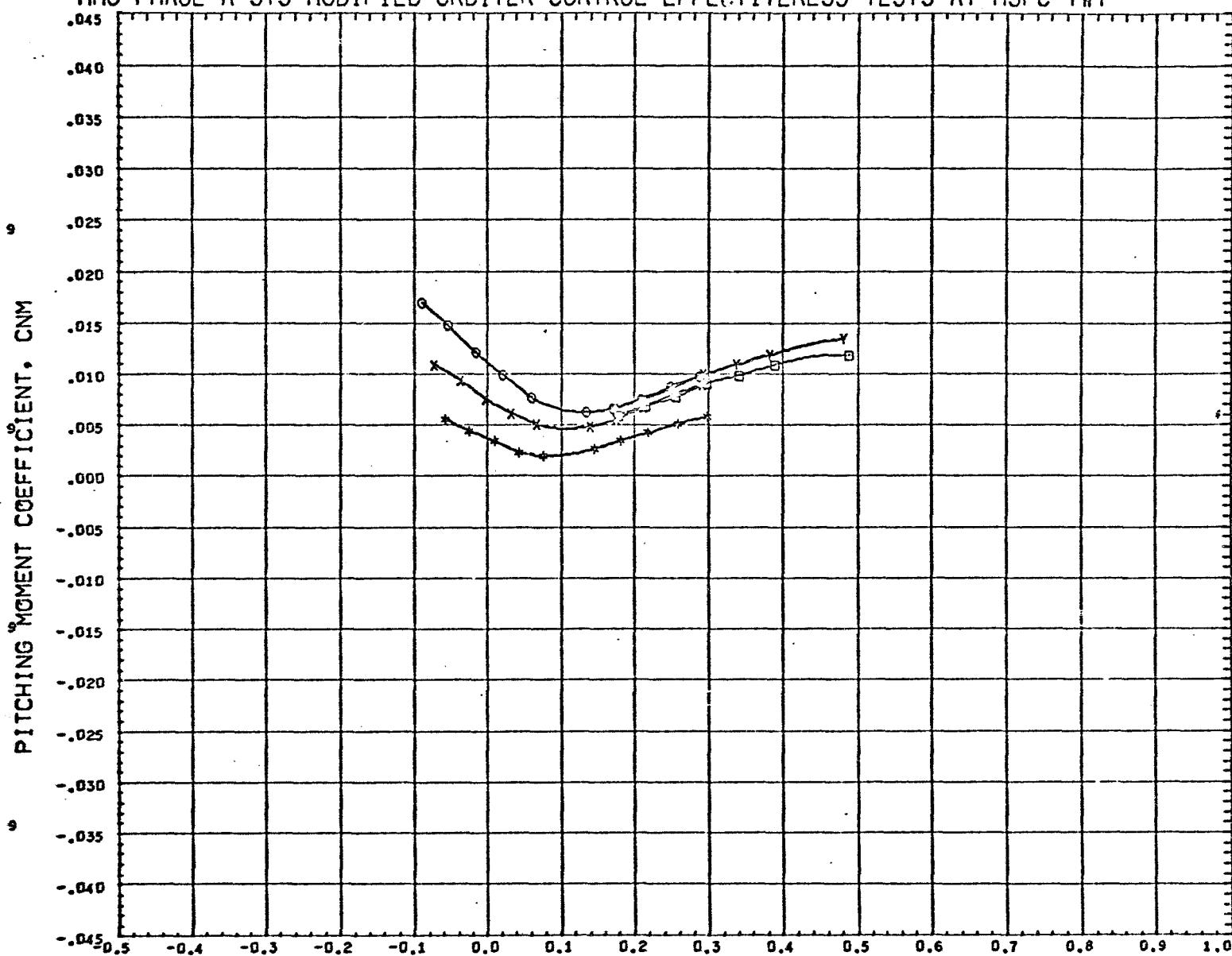
MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC HOD ORB B2W2T1R1 E=OFF	(X17024)	02 JUL 70	2.740	REFS 0.116 SQ.FT.
X	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=0	(X17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=-15	(X17026)	02 JUL 70		REFB 0.405 FT.
C	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=-30	(X17027)	02 JUL 70		XHRF 0.406
Y	MSFC 453 MMC HOD ORB B2W2T1E1R1 E=-30	(X17029)	02 JUL 70		YHRF 0.600
					ZHRF 0.645

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



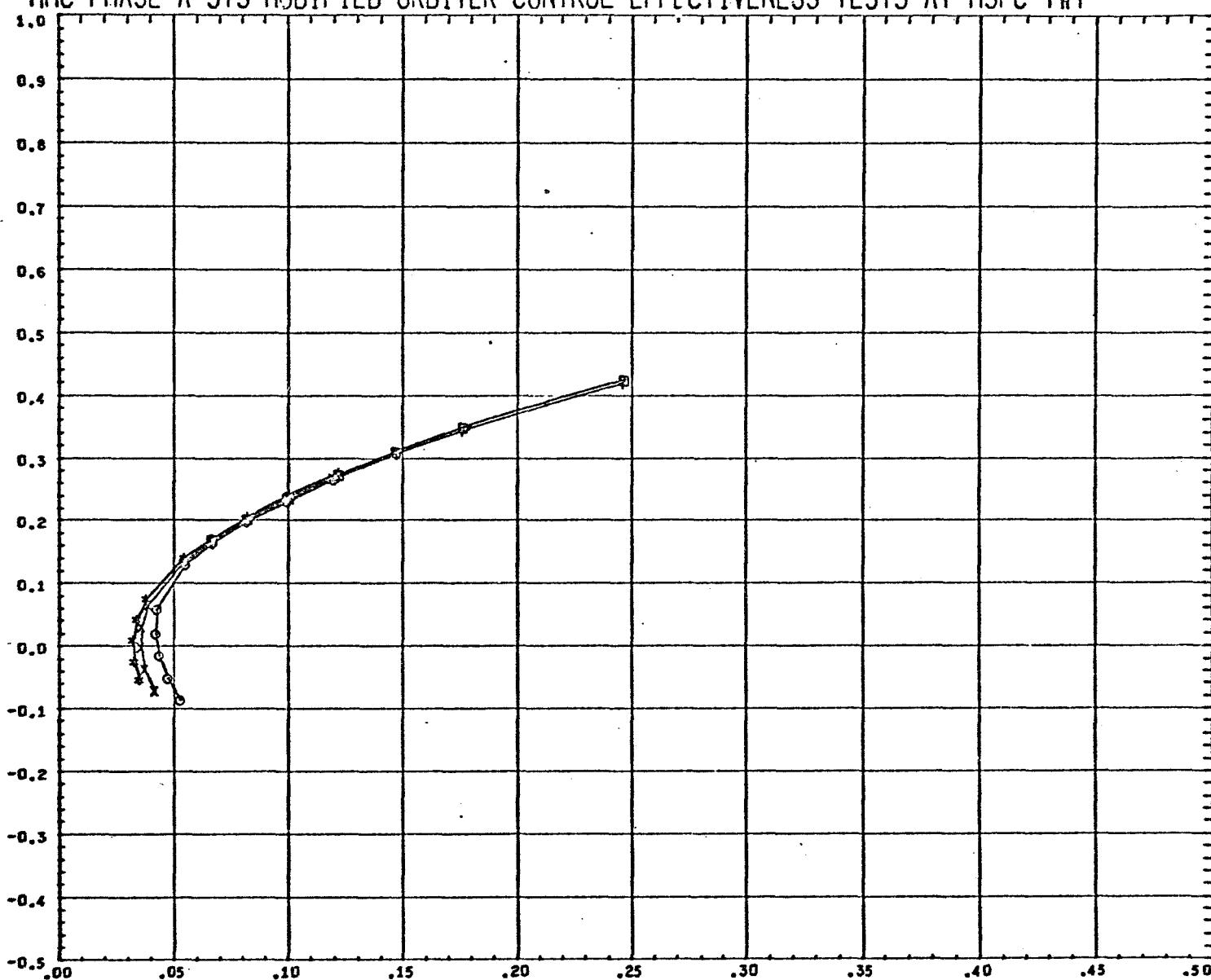
NORMAL FORCE COEFFICIENT, CN

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=0	(G17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
x	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-15	(G17026)	02 JUL 70	REFL 0.646 FT.	
G	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-15	(G17028)	02 JUL 70	REFB 0.495 FT.	
G	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-30	(G17027)	02 JUL 70	XHRF 0.406	
T	MSFC 453 MMC M00 ORB B2W2T1E1R1 E=-30	(G17029)	02 JUL 70	ZHRF 0.000	
					0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

LIFT COEFFICIENT. CL

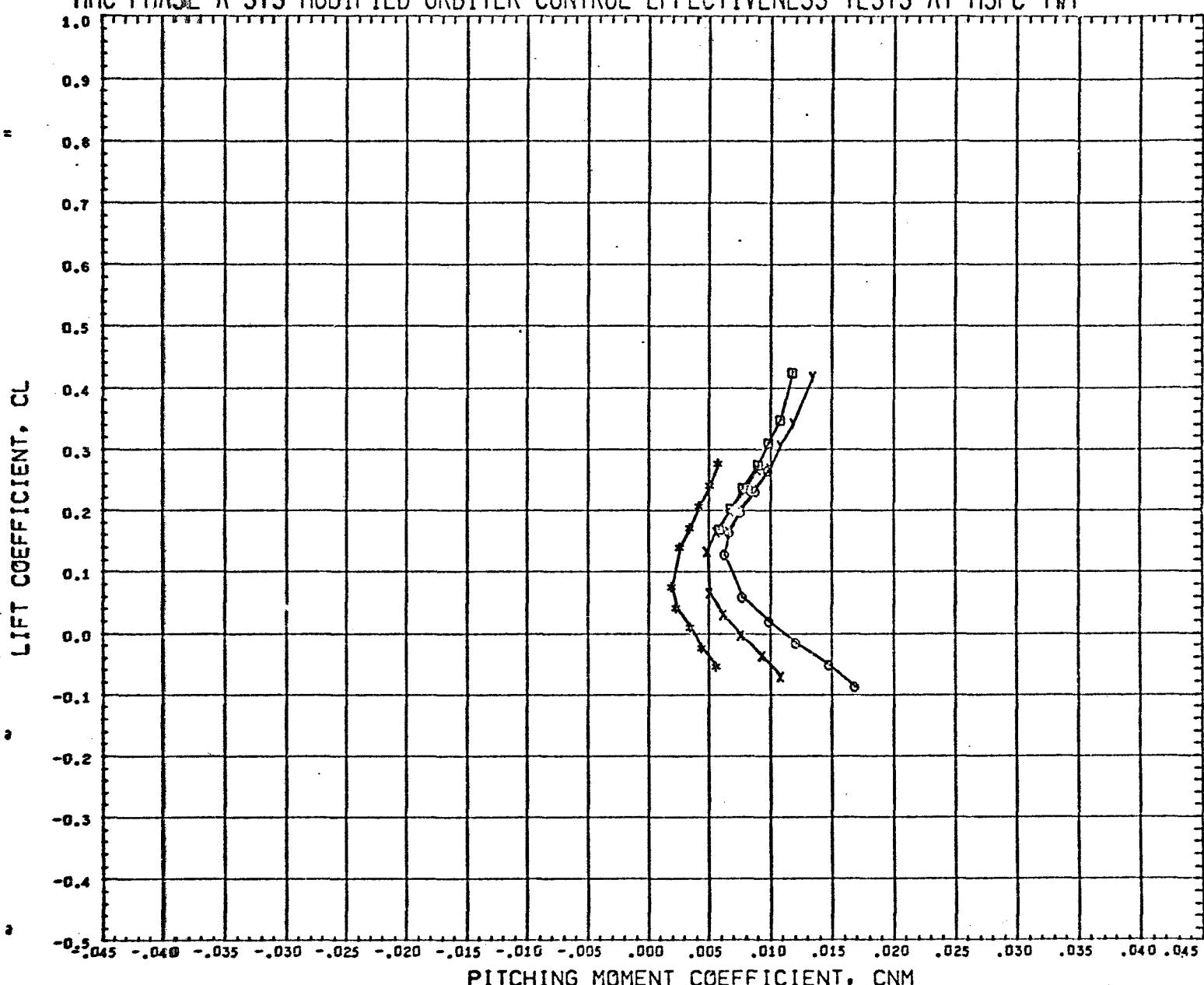


TOTAL DRAG COEFFICIENT. CD

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC HOD ORB 52W2T1E1R1 E=0	(Y17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
X	MSFC 453 MMC HOD ORB 52W2T1E1R1 E=-15	(Y17026)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC HOD ORB 52W2T1E1R1 E=-15	(Y17028)	02 JUL 70		REFB 0.495 FT.
O	MSFC 453 MMC HOD ORB 52W2T1E1R1 E=-30	(Y17027)	02 JUL 70		XHRF 0.496
Y	MSFC 453 MMC HOD ORB 52W2T1E1R1 E=-30	(Y17029)	02 JUL 70		YHRP 0.000
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



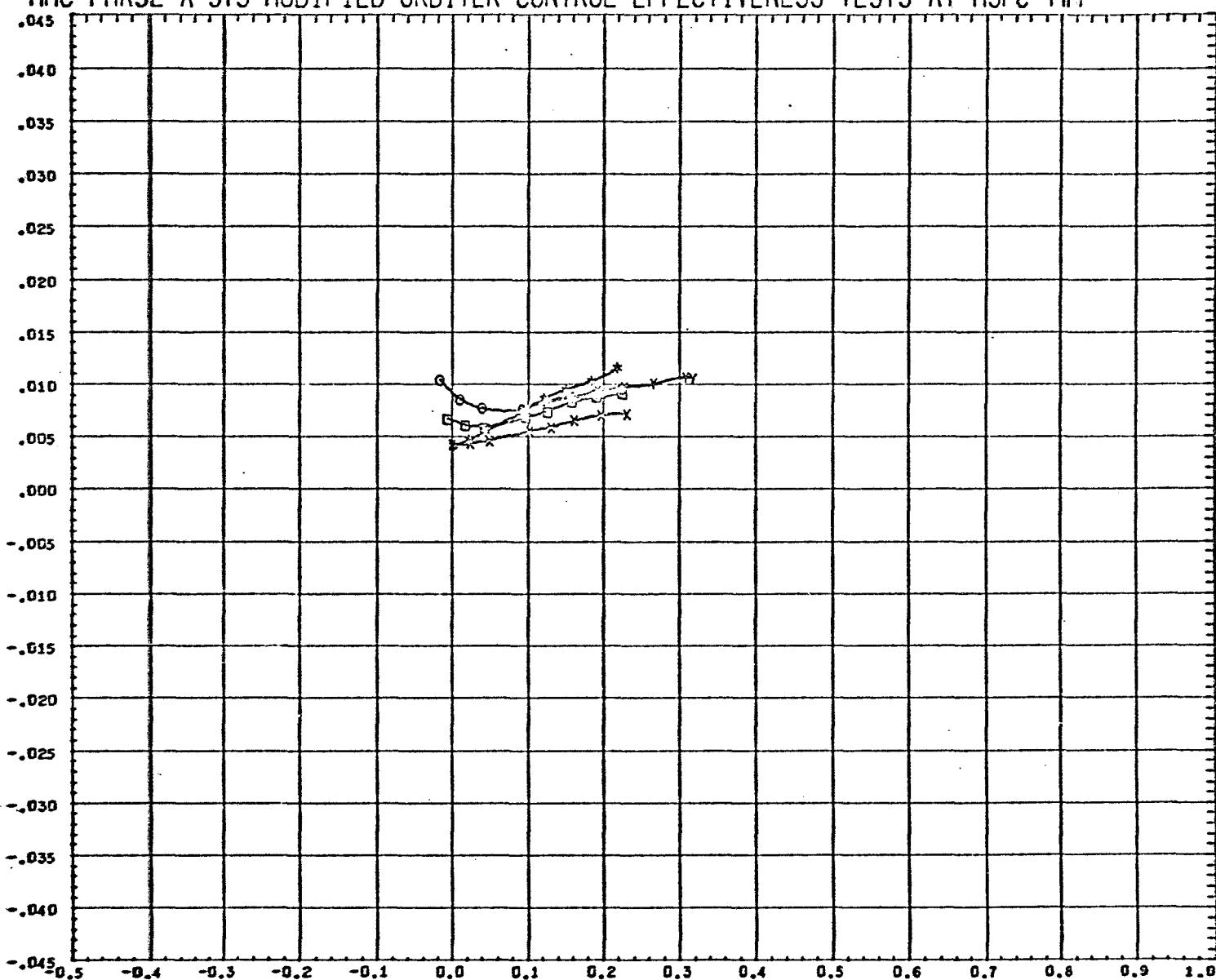
PITCHING MOMENT COEFFICIENT, CNM

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOC CRB B2W2T1E1R1 E=5	(Y17025)	02 JUL 70	3.479	REFS 0.116 SQ.FT.
x	MSFC 453 MMC MOC CRB B2W2T1E1R1 E=-15	(Y17026)	02 JUL 70		REFL 0.646 FT.
o	MSFC 453 MMC MOC CRB B2W2T1E1R1 E=-15	(Y17028)	02 JUL 70		REFB 0.405 FT.
o	MSFC 453 MMC MOC CRB B2W2T1E1R1 E=-30	(Y17027)	02 JUL 70		XHRP 0.406
y	MSFC 453 MMC MOC CRB B2W2T1E1R1 E=-30	(Y17029)	02 JUL 70		YHRF 0.000
					ZHRP 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

PITCHING MOMENT COEFFICIENT, CNM

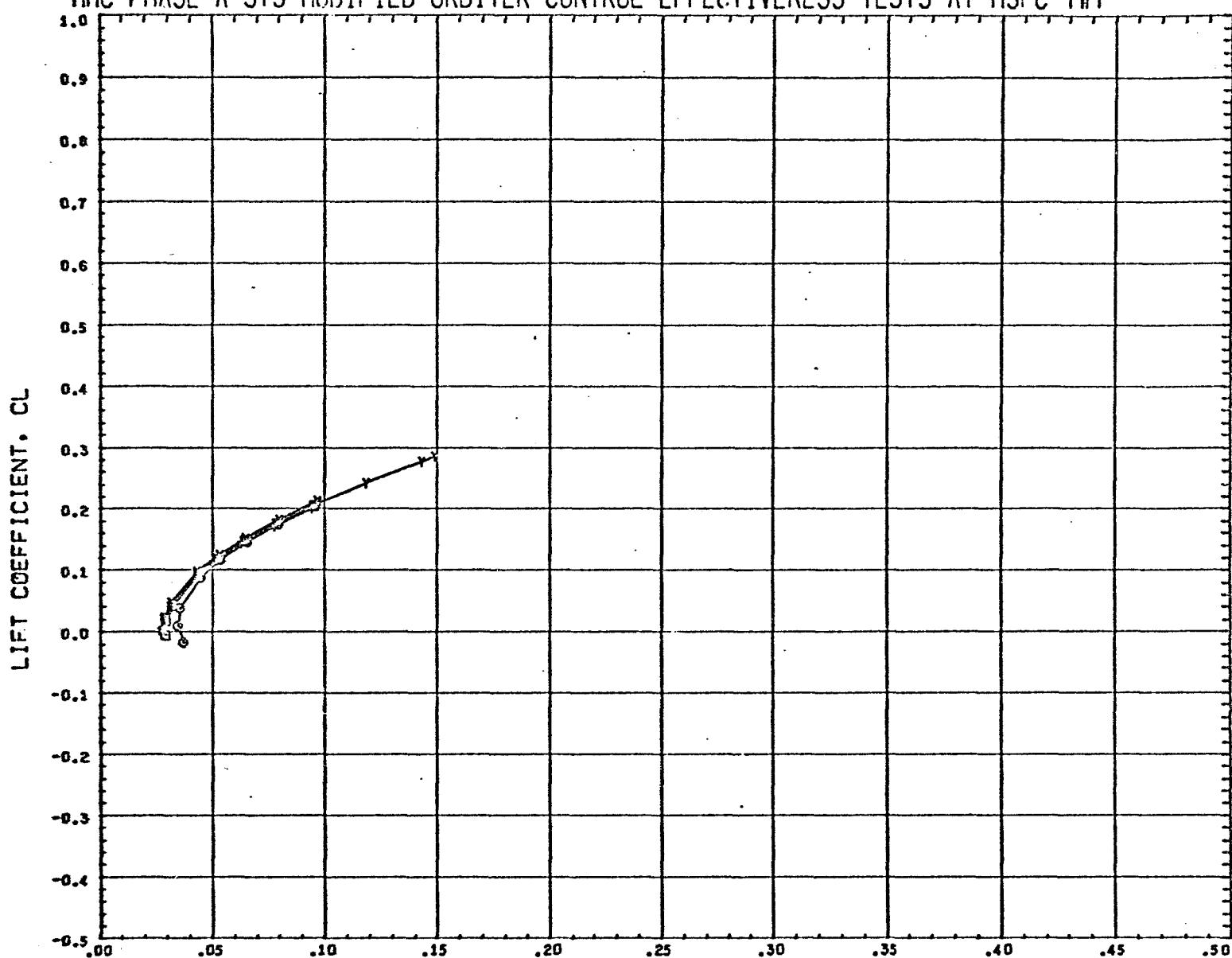


NORMAL FORCE COEFFICIENT, CN

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(H17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(H17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(H17026)	02 JUL 70		REFB 0.495 FT.
Q	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(H17027)	02 JUL 70		XMRF 0.456
Y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(H17029)	02 JUL 70		YMRP 0.000
					ZMRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT



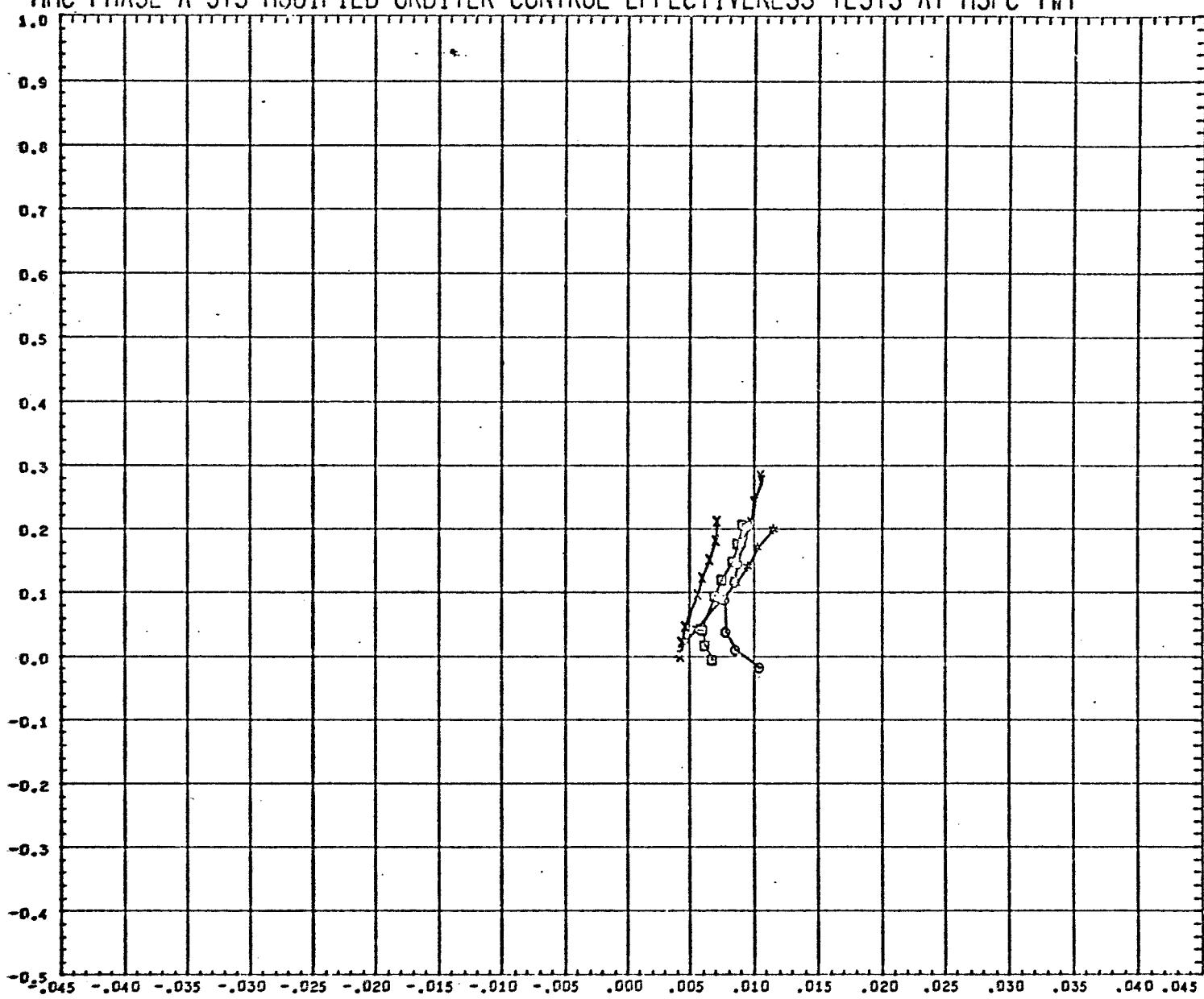
TOTAL DRAG COEFFICIENT, CD

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
●	MSFC 453 MMC MOD GRB B2W2T1R1 E=OFF	(Z17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD GRB B2W2T1E1R1 E=0	(Z17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOD GRB B2W2T1E1R1 E=-15	(Z17026)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MMC MOD GRB B2W2T1E1R1 E=-30	(Z17027)	02 JUL 70		XMRF 0.466
Y	MSFC 453 MMC MOD GRB B2W2T1E1R1 E=-30	(Z17029)	02 JUL 70		YHRP 0.600
					ZHRF 0.045

REFERENCE FILE.

MMC PHASE A STS MODIFIED ORBITER CONTROL EFFECTIVENESS TESTS AT MSFC TWT

LIFT COEFFICIENT, CL



PITCHING MOMENT COEFFICIENT, CNM

SYMBOL	CONFIGURATION DESCRIPTION	DATA SET	DATE	MACH NUMBER	REFERENCE INFORMATION
*	MSFC 453 MMC MOD ORB B2W2T1R1 E=OFF	(Z17024)	02 JUL 70	4.960	REFS 0.116 SQ.FT.
X	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=0	(Z17025)	02 JUL 70		REFL 0.646 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-15	(Z17026)	02 JUL 70		REFB 0.405 FT.
G	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(Z17027)	02 JUL 70		XHRF 0.406
Y	MSFC 453 MMC MOD ORB B2W2T1E1R1 E=-30	(Z17029)	02 JUL 70		YHRF 0.000
					ZHRF 0.045

REFERENCE FILE.

PAGE 200